AMATEUR WORK

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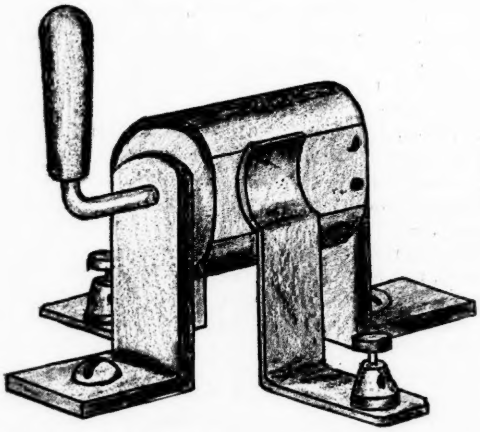
INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

VI. Current Reverser and Spark Gap.

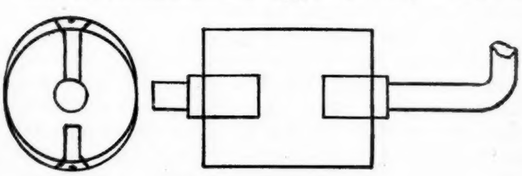
With all except the very smallest of coils, it will frequently be found desirable to have a current reverser by means of which the direction of the current through the primary winding may be quickly changed. In using Geisler tubes it is quite an interesting experiment to thus change the current, and note the color changes at the terminals of the tubes.



There are two forms of reversers in common use; the three point, two arm switch, and the ellipsoidal form having two brass contact surfaces, and the circuits completed through the shaft, shaft bearings and flexible contact springs, as shown in the illustration. The dimensions here given are suitable for a coil giving a two-inch spark, and may be reduced for smaller coils, but need not be enlarged for coils giving up to eight-inch sparks. To turn out a finely finished job will require a lathe having a slide rest and chucks, but passable work may be done with a hand drill and taps.

The first work will require a piece of round hard rubber rod $\frac{7}{8}$ in. long and 1 in. diameter. Find the exact center of each end and drill $\frac{3}{8}$ in. holes $\frac{3}{8}$ in. deep. In these holes is mounted the shaft, which is in two pieces, the intercepting section of the rubber serving to insulate the two sections. The shapes of the two sections of the shaft are given in the illustration and they are turned or filed out of a piece of round steel.

A piece of brass tubing, 1 in. inside diameter and $\frac{7}{8}$ in. long is then slipped over the rubber; holes are drilled, countersunk and tapped for two $\frac{1}{8}$ in. machine



screws on opposite sides of each end. The screws must be long enough to reach into the shaft a short distance; the latter being drilled for same, after locating the points by boring the holes above mentioned. These screws serve the desirable purpose of keeping in place the sections of tubing and shaft ends.

When this work is completed, the heads of the screws are filed to conform to the surface of the tubing, which point should be kept in mind in countersinking the holes for same, so that the heads will not sink too deep. The important point is to be able to file the heads of the screws down so that but little of the slot remains, just enough to take a screw driver, should it ever be necessary to take it apart.

The larger end of the shaft is bent to a right angle and fitted with a hard rubber or composition handle. A suitable handle can be obtained from a cheap button hook. It is fastened to the shaft with shellac, after first roughing the shaft fitting some with a file.

The shaft should be so fitted to the rubber tubing that the handle will be exactly vertical when the springs rest easily upon the rubber; when turned horizontal in either direction the springs rest upon the brass faces.

The spring contacts are bent up from strips of spring brass, the top ends being bent as shown, and the bottom ends thrust out at right angles and holes drilled to receive the screws for binding posts.

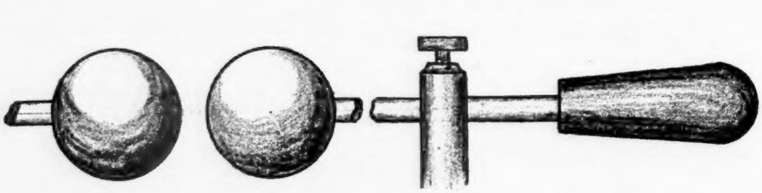
In connecting up, one end of the primary is connected with the wire from the condenser to the vibrator. The positive and negative wires from the battery are connected to the binding posts. It will be evident that when the handle is thrown horizontally to one side the current will pass in one direction. When the handle is vertical no current will pass, and it will be found very handy when adjusting the apparatus, thus to be able to throw off the current without disturbing the connections, as well as effecting a considerable wear on the batteries.

In many experiments with a coil it is desirable to make use of discharging balls, and this is especially true of wireless telegraphy. To make such balls, obtain two brass curtain pole ends, which are made of spun brass and come fitted with screws for attaching to curtain poles. These screws must be removed, which may be done by sawing them off with a hacksaw, leaving the heads inside the balls, which is not objectionable, or the small caps surrounding the screws may be unsoldered with a blow pipe and the screws removed. The latter method should not be used, however, unless the worker is rather skilled in soldering, or the resoldering of the cap is done by a jeweller, which service may be obtained at small expense.

If the screws are sawed off the brass rods carrying the balls are inserted a short distance into the screw holes and fastened with solder. If the screws are removed by taking off the cap, the rods are first soldered to the caps and these in turn soldered in place on the balls. Whichever way is used, all excess solder should be removed with a small, smooth file, and the joint polished with fine emery cloth, as all abrasions and points serve to dissipate electricity. The appearance of the balls is improved by a coating of thin lacquer.

Rubber or composition handles are fitted to the outer ends of the rods, after passing the same through the secondary terminal posts. These handles may be taken from the large button hooks, as previously mentioned for the current reverser.

A word of caution may be desirable to novices in the use of coils: Do not undertake to adjust the spark gap or connected apparatus when the current is on. The brush discharge from any, except the very small coils, is quite enough to give a severe shock. It is quite probable that in a moment of carelessness, however, most of us learn how true this is.



ELECTRIC DERRICK.

A novel application of electricity in the handling of iron and steel is now in operation in Cleveland, Ohio, in the way of a magnet.

This form of magnet consists of a large iron disk supported by chains, which may be fastened to the hook of a derrick or crane block. To the top of the disk is applied an electric plug device connected with insulated wires, which by an ingenious auxiliary pulley arrangement are led to a controller at some convenient point at the base of the derrick or in the operator's cab of the crane. The disk is lowered over the material to be lifted and the current turned on, and in this way enormous loads of material may be gathered together and held by the magnet as long as the current remains connected. Different forms of the disk are made for handling pig iron, heavy melting stock, such as crop ends, butts, steel risers, small castings, tin scrap, whether loose or in bales, shearing scrap, rod scrap, bolts, nuts, punches, rivet spikes, rail ends, machine borings, flats, sheets and, in fact, almost any form of iron or steel which affords a surface sufficiently large for the magnet to act upon. When the material has been carried to the place where it is to be deposited the current is turned off and the magnet at once releases the load. Scrap tin has always been an ugly form of material to handle satisfactorily, but by the use of this device it may be disposed of as rapidly and as easily as heavier stock.

At the present time all wire is made by the drawing process, and while permitting the production of a much thinner wire than could be obtained from the rolls, it also gives a wire of greater tensile strength, so much so that the smaller the size to which the wire is drawn down, the greater is its ultimate breaking strength.

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DOVETAIL JOINTS.

These are employed chiefly for uniting wide and comparatively thin pieces of wood at right angles, as the sides and ends of box-like constructions. But the dovetail can be employed in many other circumstances and it is not by any means the only form of joint, or even the one most frequently adopted, for jointing under the conditions mentioned. In particular classes of work, however, the dovetail is invariably employed. In cabinet making dovetail joiuts are constantly used; in joinery and in pattern-making, less frequently; and in heavy carpentry scarcely at all. One reason for this is that in cabinet work appearance is a consideration of much importance. Another is that joints must be made as secure as possible in themselves, so that they can be held by glue alone. In a rougher class of work equal strength can be attained with less labor by the freer use of screws, nails, bolts, and other means of attachment between parts more simply fitted.

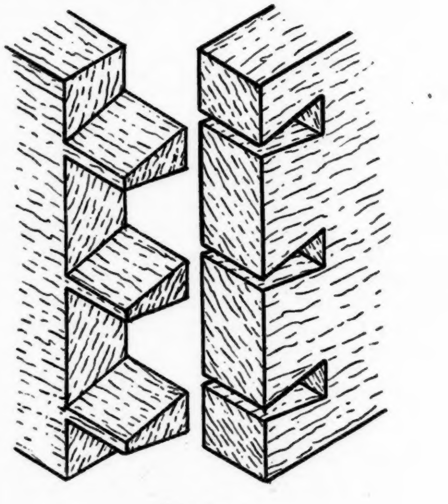

Fig. 1.

Well fitted dovetail joints are so strong that for most purposes there is no advantage in using anything besides glue to hold them together; but occasionally in carpentry and pattern work they are nailed as well. When they break it is not usually by direct pulling apart in either direction, but as the result of racking strains across the corners of the frame. If these are sufficiently severe the dovetails shear away in line with their grain.

Dovetails may be divided into three classes—common, Figs. 1 and 2; lap, Fig. 3; and secret, Fig. 4. The first two are the strongest and most easily made, the others only being preferred in some cases for the sake of appearance. The common kind may again be divided into two varieties—those in which pins and dovetails are of equal width, Fig. 2, and those in which the pins are narrower—generally about one-fourth the

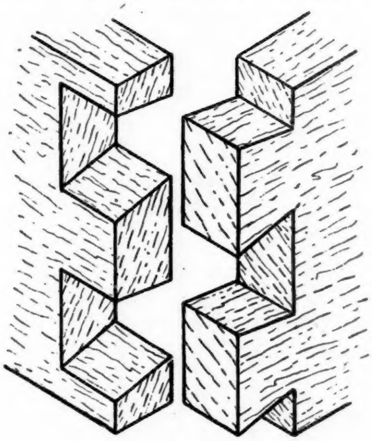

Fig. 2.

width of the dovetails, Fig. 1, or in some cases as narrow as it is possible to make them, their thinnest part being only the width of a saw-cut. Of these varieties,

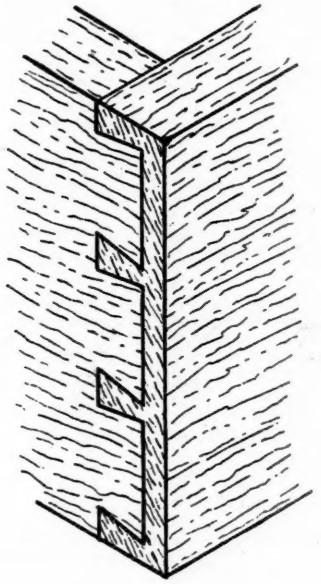

Fig. 3.

the equally divided type, Fig. 2, is the stronger, because each piece of wood is cut away to the same

amount, and the parts interlock at equal intervals. The appearance of this joint, however, is not considered so good as that in Fig. 1, and consequently the form shown in Fig. 2, which is known as the "cistern dovetail," because it is employed for cisterns and similar large, heavy boxes, is scarcely ever adopted in cabinet work.

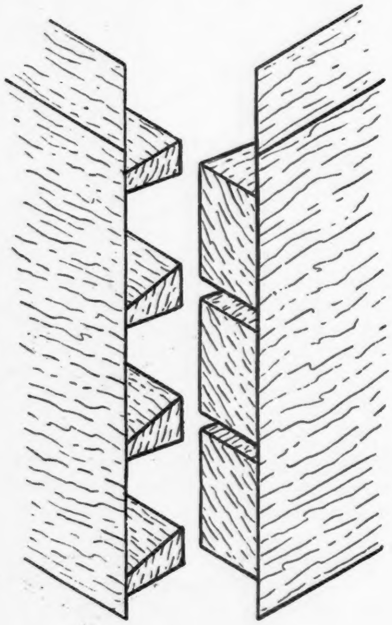

FIG. 4.

Lap dovetails, Fig. 3, are used chiefly for drawer fronts, the front generally being about ¼ in. thicker than the sides of the drawer, and this extra ¼ in. is used as a lap to conceal the dovetails, which can only be seen from the side when the drawer is open.

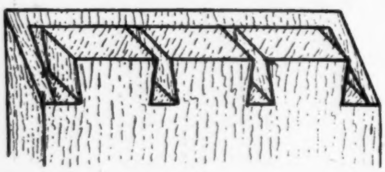

FIG. 5.

Secret dovetails, Fig. 4, are entirely concealed when the parts are together, the exterior appearance being either that of a plain mitre joint, the inner detail of one-half of which is shown in Fig. 6, or a mitre with a step or shoulder, Fig. 6, which represents the end dovetails in one of the pieces. Another form, in which the lap is not mitred, is shown in Fig. 7.

Dovetails, when done by hand, are first marked out and cut on one piece, and then transferred from that by direct marking to the piece that has to lock with them. This is more reliable than separate markings out on each piece would be, and it also renders very careful division on the first piece unnecessary. The pieces to be united must first be planed to thickness

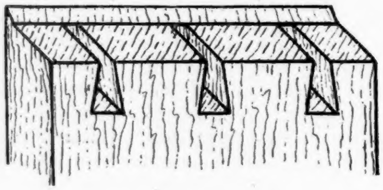

FIG. 6.

and width, and squared to length. This, of course, must be accurately done. Then a gauge is set to the thickness of the stuff, and lines are gauged from each end completely around each piece—that is, if the pieces to be dovetailed are 1 in. thick, lines are gauged 1 in. from the end of each piece across faces and both edges. Usually the pieces to be jointed are of similar thickness; but if they are not the parts must be gauged accordingly. It is now a matter of choice whether the pins or sockets shall be marked first. The projections on the left-hand parts of Figs. 1, 2 and 4 are called the "pins," the spaces which these fit into the "sockets." Many saw the pins first, but for work done in quantity it is better generally to take the sockets first, because a number of pieces can then be clamped together and cut without separate marking for each. It is not really essential that dovetails should be marked out other than by the eye; but careful men will divide and mark them with a bevel.

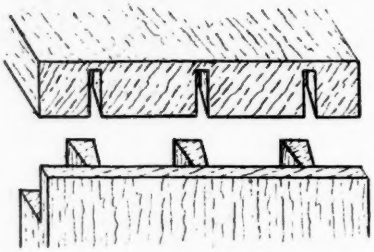

FIG. 7.

If a box or frame which has to be dovetailed together is longer in one direction than in the other, the longer pieces, or sides, are selected for the sockets and generally a half-dovetail is allowed at each edge of these pieces, Fig. 8. To mark them out properly a line, 0 0, Fig. 8, is gauged midway between the end of the wood and the root of the dovetails, which latter is already indicated by the

lines previously gauged, and marked 1 1 in Fig. 8. The divisions are made on the line 0 0. If we take now about a third of the thickness of the material we shall have suitable width for the sockets on the line 0 0, and if we make the dovetails or intervening portions of wood four times that amount we shall have a good proportion for each.

however, it must be kept slightly to one side of the original mark to prevent the pins from being a loose fit. By the other method the sockets are first cleared out, and the marking done with a scriber, Fig. 10, the pieces in either case being adjusted in the same way in their correct relation to each other while the marking s done.

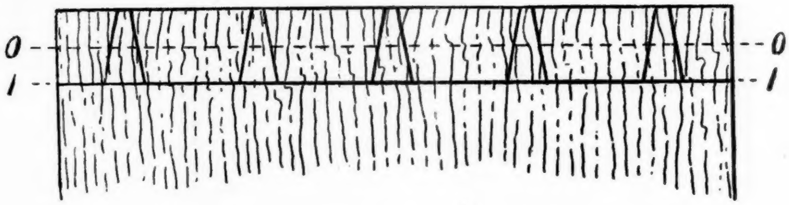

FIG. 8.

This, however, may have to be modified to make the divisions come out right on the width of the wood. A bevel is then set to the angle of 80°, which is the most suitable for dovetails, and lines are marked from the end of the wood through each of the divisions on the center line 0 0 to the inner line 1 1 at the root of the dovetails, the bevel being reversed to mark the slope in opposite ways. A line of dovetails thus marked is shown in Fig. 8. The next step is to make a number of sawcuts through these sloping lines, stopping each cut when the saw reaches the inner line 1 1. The sockets may now either be cleared out before the other part on which the pins have to be cut is marked, or the marking may be done through the saw cuts.

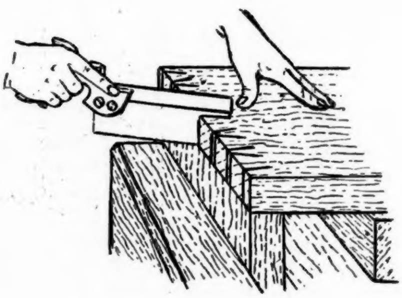

FIG. 9.

If the latter method is followed the piece to be marked is screwed end upwards in the bench vice, and the piece which has been sawed is laid with its end in correct position on top of it, Fig. 9. The marking is then done by the end of a dovetail saw inserted in each cut in turn and drawn over the end grain of the upright piece sufficiently for the teeth to leave a mark, which is sawed to after the top piece has been removed. In starting the saw afterwards,

By these methods, of course, no fitting is supposed to be afterwards required, the only parts that are touched with a chisel being the end grain at the roots of the pins and dovetails. These are cut slightly concave from each face of the wood to insure a close fit at the external faces. In small dovetails these portions are removed by a chisel and mallet in the same way as mortises are cut out with a bow or keyhole-saw, unless a bandsaw is available. Sometimes they are bored out, but in all cases a chisel is used to finish to the line.

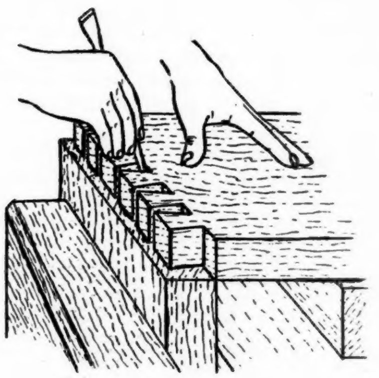

FIG. 10.

The part should be tried together before gluing. The glue should be applied to both parts, using a slip of wood if the sockets are too narrow to insert a brush. The parts should be an easy driving fit, and a block of wood is laid across the surface to receive the mallet or hammer blows, which would bruise the surface, and be rather too local is delivered direct.

Lap dovetails are more troublesome to cut because the saw cannot go through where the lap occurs. The marking out from this of the lapped piece is very simple, the end of the piece merely having to be adjusted

to a line which leaves the thickness of the lap beyond. This line is gauged from the inside face, with the gauge set to the length of the dovetails of the first piece. The scribing or saw marking is then done as before. Fig. 10 shows the parts in position for marking a lap dovetail. In cutting the spaces out, however, and forming the lap, most of the work has to be done with a chisel.

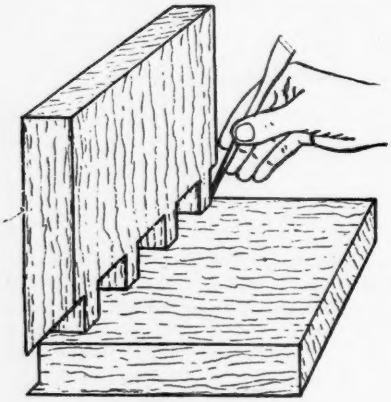

FIG. 11.

The secret dovetail, Fig. 4, may be regarded as a double lap with the laps mitred. A thickness of about one-fourth of the total is gauged from the exterior faces of both parts on the ends, and also on the sides if the mitre is to be carried across them. Then a similar distance back is gauged on the inner faces, representing the amount the lap extends beyond the dove-

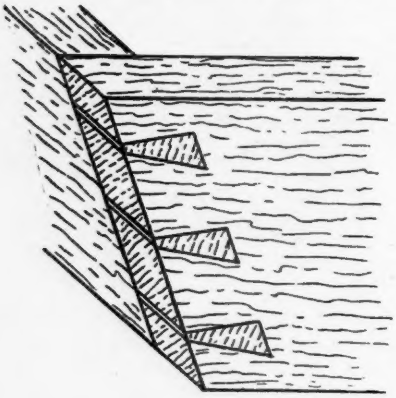

FIG. 12.

tails each way. In this case it is better to mark and cut the pins first because if the other procedure is followed, it is difficult to mark through the narrow entrances to the sockets, for the outside being closed by the lap, the marking has to be done from the back, as shown in Fig. 11. In these cases the rebate at the front should be cut before the dovetails are proceeded with.

The dovetails in this kind of joint are often continued along the complete width of the stuff, and only the front faces are mitred, leaving the joint edgewise like Fig. 6. This rather simplifies the work, but it is not, strictly speaking, a secret dovetail, as that in Fig. 5 is, in which the mitre extends over the edges as well as where the faces meet.

Another variety of dovetail sometimes required and rather troublesome to mark out, is that shown in Fig. 12, in which the dovetailed parts meet at right angles, but slope, or are splayed depthwise. In such cases it must be borne in mind that the dovetails must be parallel with the edges of the wood, and can only be marked from the sloping ends by having bevels set to two different angles, which must first be discovered by marking two oppositely inclined lines at 10°, with the edges. The pins may be gauged from the edges or a bevel set to the angle may be used; but they cannot be squared from the ends, as in other work.

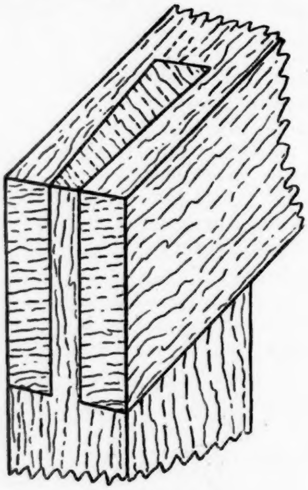

FIG. 13.

The remaining Figs., 13 to 16, show examples of dovetail joints in other circumstances than the box-form constructions of the preceding figures. Some of these are common in carpentry and pattern making. Fig. 13 is a single dovetail uniting at right angles the ends of the two pieces that are nearly square in section, and consequently not suitable for jointing by a series of interlocking projections and recesses, as in the previous cases. In a case like Fig. 13, it is a matter of considerable importance as to which piece the pin is formed on, for it is obvious that the joint would stand a great deal more internal pressure against the dovetail than at right angles to it, where it would only

CONCLUDED ON PAGE 304.

CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

IV. Vaporizers and Carburettors.

Before the gasoline can be used in the cylinder of an engine it must be converted into vapor and mixed with the proper proportion of air. The devices for performing these functions are termed vaporizers or carburettors. Although a certain distinction may be made between the two, their functions are the same and their methods of operation quite similar.

The fundamental principle of their operation is the picking up of the gasoline by a current of air; the gasoline in practice flows out of a small orifice direct into the stream of air which is drawn in by the suction stroke of the engine. The relative proportions of gasoline and air must, of course, be nicely regulated, as the proper mixture is far more effeetive than one either too weak or too rich. All vaporizers or carburettors to properly perform their duties should be provided with means for regulating the flow of both the gasoline and air.

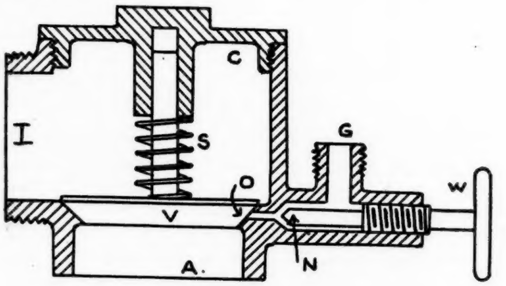

FIG. 19.

The simplest form of vaporizer, or mixing valve as it is sometimes termed, is shown in Fig. 19. It consists of a brass casting containing the valve V and its seat, and having the openings, *G*, *A* and *I*. It is attached to the crank case of the engine by the threaded end *I*.

The gasoline enters at *G*, flowing around the needle valve *N* and into the very small opening at *O*. The valve V has a spindle extending upwards and fitting the hole in the cover *C*. This stem acts as a guide to the valve and assumes its seating correctly after being raised. The spring *S* is inserted to return the valve to its seat quickly. The needle point *N* may be moved in or out by the thumb nut *W*, thus regulating the flow of the gasoline. The valve *V* when seated covers the needle opening *O* preventing the escape of the gasoline.

This form of vaporizer is most commonly fitted to two cycle two port engines. The suction created in the crank case by the upward strokes of the piston causes the valve V to raise and the air to rush in through the opening. The raising of the valve uncovers the needle opening *O*, and allows the gasoline to flow out into the incoming stream of air, which immediately absorbs it. The mixture thus passes into the crank case and is ready for use. As soon as the piston has reached nearly the top of its strokes and the suction has ceased, the valve *V* returns to its seat by its own weight, aided by the pressure of the spring *s*, and prevents the escape of the gases on the downward compression stroke; this valve *V* is the non-return valve mentioned on page 211 of Chapter I.

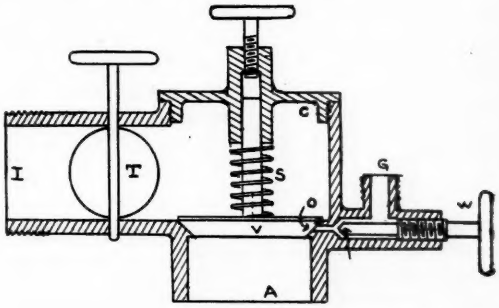

FIG. 20.

This vaporizer has no means for adjusting the supply of air. only the gasoline supply being variable. It is, consequently, not very sensitive. It is, however, owing to its simplicity, suitable for small engines, where it gives good results. For engines of large size this type of vaporizer is not sufficiently sensitive.

A more approved type of generator is shown in Fig. 20. Its principle of action is the same as that just described, but in addition to the parts already named, has the wheel *R*, which screws down on the stem of the valve and thus regulates its lift. It also has a sort of shutter or throttle valve *T*, consisting of a disc which may be turned to partially or wholly close the opening.

The proportion of the mixture may be varied as follows: The gasoline opening may be varied by the needle point *N* and the thumb wheel *W*, giving a weaker or richer mixture. The air supply is regulated by the screw *R*, which varies the lift of the valve *V*. These adjustments allow the regulation to suit the different conditions of running the engine. The spring *S* is fitted in order to make the valve seat more quickly without loss of crankcase compression, and thus allow the en-

ine to run at higher speed than would otherwise b e the case.

For regulating the speed of the engine a throttle, consisting of the disc *T* is placed in the inlet. It may be turned by the small handle outside and thus regulates the amount of the mixture without change in its proportion. The same result may, of course, be accomplished by the manipulation of the screws *R* and *W*, but in doing this the best proportions of the mixture may be lost and readjustment required. Some of the cheaper generating valves for this reason are not furnished with the throttle, but it is far more satisfactory to have one with this fixture.

The cap *C* may be unscrewed allowing the valve *V* to be taken out.

Vaporizers of this type are suited to two cycle engines of the two port type, which require check, or non-return valve on the crank case. For three port and four cycle types some form of float feed carburettor may be used to advantage.

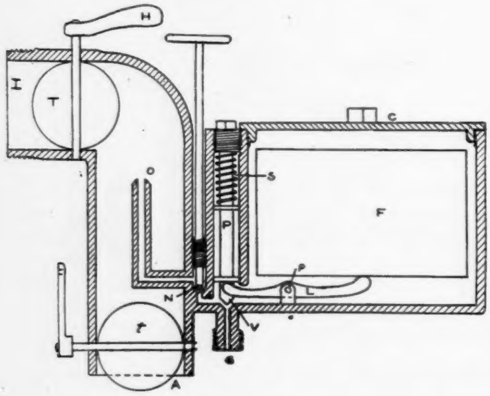

FIG. 21.

Although, as before stated, there is no difference in the function of vaporizers and carburettors, those of the types just described are commonly called vaporizers or generating valves, while those governed by a float and having no check valve are usually termed carburettors.

Fig. 21 shows the elements of the float feed carburettor which consists of a chamber containing the float *F*. Leading from this chamber is the small opening containing the needle valve *N*. The gasoline enters at *G*. At *V* is a small valve attached to the float which closes the opening of *G* when the float rises; the float is guided by the two stems as shown. The gasoline passes through the needle valve *V* and up the vertical tube to the opening *O*; the height of the opening *O* is so adjusted that the level of the gasoline is just below it when the float is in its highest position and the valve *V* is closed. The air, drawn in by the suction stroke of the engine, rushes past the opening *O*, draws up and absorbs a portion of the gasoline. At *w w* is a cone of fine wire gauze which catches any gasoline not taken up by the air current and holds it suspended ready to be taken up at the next stroke.

At *T* is a sort of shutter or throttle which may be turned by the handle *D* and wholly or partially close the opening *I* and thus regulate the amount of the mixture passing to the engine and consequently the speed; the gasoline supply is regulated by the needle valve *N*, as before. A small arrangement is sometimes fitted below the needle valve to regulate the air supply independently.

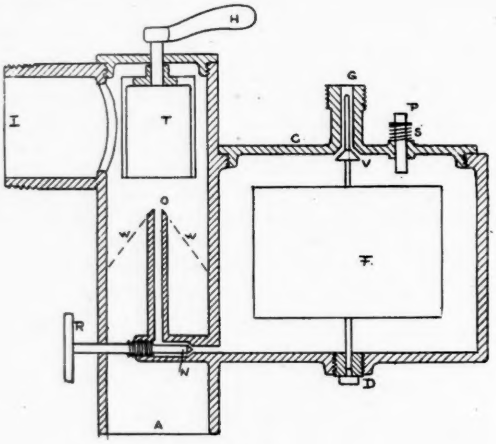

FIG. 22.

The float *F* is made usually of copper, although sometimes of cork; it is guided by the small stems as shown. At *P* is a small plunger for forcing the float down for the purpose of flooding the opening *O* and making certain of the flow of gasoline. The cover *C* unscrews to allow access to float chamber.

In operation, as the gasoline is drawn up by the air, the level in the float chamber falls slightly, finally opening the valve V, admitting gasoline and restoring the level, whereupon the float rises, closing the valve V and stopping the flow. Thus the level is maintained constant and the same amount of gasoline drawn out at each stroke. The proper mixture is obtained by the proper relation of the air and gasoline supplies.

Fig. 22 shows another form of carburettor, whose operation is similar to that of the one just described but which has, however, some points of difference. The gasoline is admitted at *G* as before, the valve V, however, is a separate piece and is held down to its seat by the spring *s*; the lever *L*—which is pivoted at *p* is forked and rests just below the projection on the valve V; the float *F* is free and rests just above the long end of the lever.

When the float *F* settles, owing to the using of the gasoline, it strikes the end of the lever *L* and presses it down by its weight, thus raising the valve V

and admitting more gasoline. When the level has risen sufficiently the float ceases to press in the valve V, and it closes. The usual needle valve is at *N* and the orifice at *O* as before. At *I* is a disc which may be turned across the opening and act as a throttle to regulate the speed of the motor. At *t* is a similar disc to regulate the air supply; by means of this disc *t* and the needle valve *N* the correct proportion of air and gasoline may be maintained.

Although the actual details of the different carburettors will differ greatly, the principles governing their action will be found to be similar to the above, and the several parts will be found in one form or another.

It is necessary for proper performance that means should be supplied for the regulation of both gasoline and air supplies. Owing to varying atmospheric conditions the relative adjustments will require changing from time to time. Even for starting the engine a different adjustment may be required from that under which the engine will run after being warmed up. Any carburettor not having these adjustments is likely to give trouble in starting the engine.

The advantages of the float feed carburettor over the mixing valve are: The check valve is done away with, avoiding the noise and loss of the suction necessary to raise it; a more uniform mixture is obtained, as the gasoline is always at the same level; this is especially true in a sea, as there is a sufficient body of gasoline in the float chamber to draw upon at times when the boat is pitching and the tank is perhaps lower than the vaporizer, and the flow would otherwise be interrupted, causing the engine to work irregularly; the speed may be more easily controlled, and the engine may be run at a slower speed where the suction would not be great enough to raise the check valve of the vaporizer.

The vaporizer or generator valve is fitted to two cycle two-port engines which require a check valve. For two-cycle three port engines some form of float feed is used. The float feed may also be fitted to the two-port type by the addition of a check valve between the carburettor and the engine. Some forms of float feed carburettor are fitted with a check valve for this purpose. The four-cycle engine is commonly fitted with some form of carburettor.

Warm air will absorb a greater amount of gasoline than cool air; for this reason the air inlet *A* is usually connected to a pipe which can draw air from some warm place, such as around the exhaust pipe or between the cylinders. A very common idea is to encircle a portion of the exhaust pipe with a perforated sleeve of thin iron with an outlet leading to the air pipe; in this way the carburettor is supplied with warm air. The vaporizing of the gasoline also draws heat from the body of the fluid and causes the carburettor to become quite cold, even so cold as to cause some trouble; this is avoided by drawing warm air from some source.

The air inlet should be protected from spray, as the presence of water will spoil the mixture. It should also be provided with a screen of wire gauge to prevent the sucking in of particles of waste, or other light substance which would cause trouble.

COCOANUT OIL AS FOOD.

Owing to the relatively high price of butter there is a growing demand for cheaper fatty foods, especially among the poorer classes.

In the first number of the "Philippine Journal of Science" a series of papers deals with the cultivation of the cocoanut palm and the production of the oil. The nuts are split in two, the "milk" being allowed to run to waste and dried in the sun or in a kiln for a few days. The "meat" is then removed from the shell and further dessicated, when it forms the copar of commerce. A number of nuts which were stored for six months and had not sprouted, were found to contain 20 per cent of shell, 34 per cent of milk and 46 per cent of meat, equivalent to 19.5 per cent of copra or 12.4 per cent of oil, the percentages being calculated on the weight of the nuts free from husks. The dried copra therefore contains over 68 per cent of oil. Analysis showed that on an average the fresh meat of a cocoanut contains 4.683 grammes of nitrogen, 2.475 grammes of potash, and 1.74 grammes of phosphoric acid.

The milk of a cocoanut contains on an average 1.542 grammes of nitrogen, 1.313 grammes of potash, and 0.171 grammes of phosphoric acid. The analytical data given are by no means exhaustive; but they are sufficient to show that as regards the high yield of oil and the presence of considerable amounts of nitrogen potash and phosphoric acid, the cocoanut possesses a distinctive nutritive value. As cocoanut oil has been largely employed as a food without the production of unfavorable results, and as it is sold at less than half the price of butter, there would appear to be good reasons for the further extension of its use as an alternative to butter, especially since its peculiar flavor has been eliminated by a process of purification.

In cases of poisoning by illuminating gas, the treatment is most energetic. The patient should be brought into the open air at once, the clothing loosened and hot bottles applied to the extremities. If the air passages are blocked by vomited matter, these should be cleaned. Active rubbing of the skin with coarse towels, mustard water applications to the extremities, and artificial respiration should be instituted. The breathing of camphor vapor, or well diluted ammonia gas, may help the breathing. So long as the heart beats there are hopes of reviving the patient.

CASEHARDENING.

WALTER J. MAY.

Casehardening, as the term itself implies, means the formation of a hardened surface on otherwise soft metal, and the term is used more generally in regard to iron and steel, although to some extent a form of casehardening can be applied to copper and some of the bronzes having a high fusing temperature. Really, the process is one of alloying by absorption, and although this process in many cases causes a lot of trouble, when done with a well defined purpose it has beneficial effects. With iron and steel, carbon is absorbed, and with copper or bronze, either metallic tin, manganese or arsenic will be the hardening material; but tin is the better hardening for general use. As a rule, however, only iron and steel are dealt with, as these have the most commercial use; but it might, perhaps, be well to give the results of surface hardening on copper as done by the writer experimentally.

Ordinary wrought-iron, mild steel and malleable cast-iron will caseharden well, the last being the least satisfactory, but still for some purposes being very successful. Ordinary cast-iron, if treated by the casehardening process, would rather be softened, owing to its then being annealed with an excess of carbon, part of which would be absorbed.

In some cases only part of an article can be casehardened, while the other parts are left soft; and although this may involve some trouble, yet for particular purposes the results are worth all the trouble taken. Take, for instance, the steel rings in rice-dressing machines; if these are hard right through, they break very readily; but if the outer part is hardened and the inner parts remain soft, there is little fear of breakage. Mild steel can be used for such rings, and the saving in time and labor in cutting more than compensates for the cost and trouble of hardening. Again, it is possible to harden pinions and such like in whole or in part as is required; and certainly it is a great advantage to do machining on soft metal and then to harden the work to a reasonable depth, and possibly in some cases tempering the metal.

Outside what might be called legitimate work the process of casehardening also enables manufacturers to turn out cheap goods for trade purposes which could not otherwise be done at the price. Even knife blades can be made in soft metal, and after being rough ground can be hardened, and in such a way that they will last a considerable time, both the labor and material costs being very considerably reduced, particularly where an annealing furnace can be kept constantly hot, as in such case costs are reduced to a very small amount. Intermittent working causes a large outlay in repairs, for although no very great heat is needed, cooling and heating the furnace will cause the very best brickwork to give way in a comparatively short time, be as careful as one may. At the most, only a cherry-red heat in the boxes is needed, and as this is only about 1650° Fahr., a maximum temperature of approximately 1700° Fahr. in the oven or furnace is ample as a working heat. Still, this is quite high enough to bring down brick arches with any but careful handling, and having this occur practically means that the furnace has to be rebuilt.

When iron or steel is casehardened, the articles are packed in annealing-boxes with animal carbon, and the boxes are covered and the joints luted, then heated to just that temperature at which absorption of carbon takes place. The time the heat is continued depends on the depth of hardening required, and usually the work is thrown into water and made dead-hard as soon as it is considered that a sufficient depth is penetrated by the carbon. With the carbon may be used chemicals to assist in its absorption, cyanides being very frequently used, and according to the skill and practice of individual operators success is secured.

Thin, rather than deep boxes should be used, and in no case should boxes be too large; otherwise the hardening will be very unequal through the mass of metal enclosed. Proper boxes are made and sold at a cheap rate, the method of fixing the covers varying somewhat. In all cases small holes are pierced in the covers for the insertion of test wires, these being used to ascertain the state of the heat and the penetration of the carbon. Both circular and rectangular boxes are used, and both forms have their special uses according to the articles to be hardened; but rectangular boxes usually heat most regularly. Personally, the writer would select malleable cast-iron boxes, but possibly this is more a matter of personal preference than anything, although cost may have some bearing in the matter. The actual size of boxes will depend on the size of the articles to be treated; but unwieldy sizes should be avoided as much as possible.

The packing may be bone or leather cuttings, and these may be used raw or after conversion into charcoal. A layer of the carbonized material is laid at the bottom of the box, then a layer of the articles to be hardened is put in and packed with carbon, and the process is repeated until the box is full. Powdered potassium cyanide or prussiate of potash may be dusted over and among the articles and packing; but in all cases, phosphorus-bearing materials should be avoided, there being quite enough of this in the carbonaceous matters used. When the box is filled a layer of the packing material should be put over the articles and then the box should be closed and the cover luted down, the test wires being inserted at the same time.

Care must always be taken that the packing is thoroughly dry; otherwise the steam will force out the luting, or in some cases force off the cover, in such cases the results not being extremely satisfactory.

In packing articles which have only to be casehardened in parts, the soft portions should have a protective covering; while the parts to be made hard should be left exposed. Perhaps for ordinary purposes a mixture of white ash from the boxes and enough fireclay or pipeclay to bind the ashes would be as good a mixture as could readily be made to save the soft parts from the carbonaceous packing; but usually each operator has his own especial mixture for the purpose. Lime should be avoided unless it is desired to burn out the carbon from the iron or steel; but only in very exceptional cases will this have to be done.

Rings and such like can be rammed tight with ash free from carbon without any adhesive, and tubular articles can also be filled with ashes in the same way. Only the parts to be hardened should be in contact with the hardening material, and if this is borne in mind, then very satisfactory results are easily obtainable. At the same time, considerable practice is necessary to make an expert operator, and a good many points can only be learned by actual practice.

When the boxes are ready they must be placed in an oven in such a way as to allow the heat to circulate all round them, and when raised to the necessary heat they must be kept steadily at that heat until it is judged that the necessary depth of hardening is secured. Small variations of heat will affect the results obtained, and it is safe to say that hardly any two ovens or operators give exactly the same result in a given time. Differences in the packing material will also cause some differences in the speed of the penetration of the hardening; but it will not otherwise differ much if the operator keeps his wits about him.

Loss of time and increased fuel costs are usually resultant effects of the use of inferior packing material and often increased costs result from the use of badly-arranged ovens or furnaces, especially where the hardening boxes heat unequally.

After the boxes are placed in the oven, they should be raised to the required heat steadily and quickly, and the heat should be tested from time to time—not too often, however—by means of the test wires. The progress of the hardening can also be tested if the wires are of steel, and are quenched in cold water on withdrawal from the boxes. On breaking the wires so treated, the depth of the hardening can be readily ascertained; but this necessarily only refers to a moderate depth of hardening. Large articles to be deeply hardened can only be worked by time, the effect being noted in practical working. Some articles will require packing and firing more than once, and in regard to these experience is the only guide.

When the boxes are opened, the usual thing is to dump the whole of the contents into a rather deep water-bosh, say one a couple of feet deep, and then to extract the hardened articles when they are practically cold, when they should be almost glass-hard on the surface. In some cases running water is used, and various additions are made in other cases—solutions of salt, cyanide, prussiates and other things being used; the chief apparent object being to increase the coldness of the water, the effects of the chemicals on the metal being nearly if not quite ignored.

Some things, and particularly the cyanides of potassium or potassium and iron, appear to affect iron and steel more than is generally thought, greatly increasing the hardness of a thin layer on the surface of the metal, and for this reason should always be used with some articles; but where tempering is to be done this is not necessary.

After the articles are cooled off they should be dried and thoroughly brushed with wire brushes to leave them clean; and if to be tempered, the surface should be brightened. Any fine grinding should be done before tempering; but the final polish should only be put on after the whole of the fire-work has been performed.

Tempering is done in the usual manner, and most articles which are casehardened and tempered should be finally quenched in hot water, covered with a ¼ in. layer of some fairly thick oil, as this to some extent prevents cracking. At the same time, no hard-and-fast lines can be laid down in the matter, owing to differences in individual practice; but it is as well to remember that casehardened goods differ somewhat from those made of solid steel. The same tempering colors apply as with solid steel, however, and in this point there is no material difference. The real difference is in the fact that, instead of solid steel you have a soft metal coated with hard steel, and that these two layers do not contract so equally as an article of uniform content.

Coming to the surface hardening of copper and bronze, the surface has to be alloyed with, say, tin; and about the easiest method of doing this is to have a bath of molten tin ready at hand in which to plunge the article to be hardened; and after heating the article to as high a heat as it will stand short of fusion, to plunge and hold it in the tin until of the same temperature, and then after wiping off surplus tin, to allow the article to cool. A second or even a third heating may be necessary in some cases, and a coating of borax or boracic acid may often be of advantage; but usually one heating and plunging will be found enough for practical purposes, this rendering the surface almost too hard to file. In using arsenic the articles are packed with ordinary arsenious acid and subjected to a red heat for some hours, and the same applies to carbonate of manganese; but in general use these things are not so good as tin, according to the writer's experimental work.

Of course, the whole thing depends on the absorptive alloying of the article to be hardened, and in using arsenic or manganese these materials would be in

powder and be mixed with bone-ash, or some other inert substance to reduce cost. The heat should in no case exceed 500° Fahr., or bright red; otherwise there is danger of fusion, and this is quite high enough for any absorption process of alloying. Even a lower temperature will be found better in the majority of cases, as copper and tin will alloy at a dull red, as in the case of soldering bits when they become burnt.

The materials needed for iron and steel are either raw or carbonized bone—not bone-ash—leather cuttings, or some specially prepared casehardening material with which to pack the articles; possibly some cyanide or prussiate of potassium, proper boxes and clay luting; a good oven or furnace, and fuel which will maintain a regular heat without serious fluctuations during the time the process lasts. Possibly a mixture of gas-coke and hard furnace-coke broken to the size of eggs would give the most regular heat in some furnaces, while in others hard coal would have to be used, each furnace having its own peculiarities. For small work, gas furnaces answer well; but they usually consume a sufficiently large quantity of gas to become expensive in working, although against this can be placed the entire control of the heat, which is so necessary with fine work.

The waste from the hardening boxes should be collected and dried, as in this will be found partly consumed carbonaceous material, as well as ash, and both of these have their uses; the partly consumed material for use in backing up the new material in packing, and the ash for annealing and for coating and packing parts of articles which have to be left soft. For annealing, many articles, if they are packed with the dead ash in close boxes and kept at a full red heat for some hours, it will be found that if allowed to cool in the ash before opening the boxes, they will be softer and less oxidized than if annealed in the usual way—a point which is often of some advantage with fine work.

In using leather waste, oak and chrome tanned leather should be kept apart if possible, as the resultant hardening would be probably more pronounced with the latter form. Necessarily, if the waste is carbonized before use there can be no selection, and probably the results would be practically the same; but where raw leather is used there is a difference. It must always be remembered that carbon is not the only thing that can be got into iron and steel by absorptive alloying and with very little experiment many persons would be able to get very useful results for particular purposes. At present a good many disadvantageous results occur in places where metal is kept in contact with heated fuel and with gases of different kinds, these results being quite of an unintentional character; but if experimentalists would pay more attention to the subject, in many cases they would find it profitable.

The writer has designedly left the question of ovens or furnaces in this paper, as each one must be designed and constructed to meet the requirements of the particular work which has to be done, and except in large works, probably no general size or shape would be useful. Probably down-draught furnaces are the best, as with these you hold the heat on the floor of the furnace better. But this is a matter on which furnace-builders do not always agree, as each builder is in favor of his own particular ideas on the subject. Anyhow, efficient heating with economy of fuel is the chief thing, and when this is secured little else is to be desired.—"Mechanic and World of Science."

DRY PROCESS FOR ACETYLENE.

We take the following abstract from the "Engineers," London:

The usual method of generating acetylene and calcium carbide is to treat the material with water. The gas may, however, be obtained if the carbide be brought into intimate contact with crystallized sodium carbonate, usually known as washing soda. The action in this case is to set free acetylene and to form water, caustic soda, lime and chalk. This reaction is made use of in the Atkins dry process for generating acetylene gas. The generator consists of a drum divided transversely into three chambers. The drum, as a whole, revolves on a horizontal axis. Into one end chamber the carbide is introduced. The second or central chamber contains the soda crystals. The third chamber is filled with coke and serves for filtering the gas and holding back the dust.

This generator is revolved slowly about its axis. Motion in one direction causes a small part of the carbide to enter the second chamber, where it comes in contact with the soda. If the drum be turned in the opposite direction the carbide does not pass out of its chamber, but that portion which has entered the second chamber is mixed intimately with the soda crystals by means of a stirrer. Acetylene gas is then generated, passes through the filtering chamber, out through the hollow axis of the drum, then percolates through oil and is carried to the holder.

It is said that by revolving this generator for about twenty to twenty-five minutes, enough gas can be generated to last a residence for twenty-four hours. The generator is fitted with a safety-valve to protect it against excessive pressure, though the pressure generated at any time should be slight. The mixing chamber has a large cleaning door, through which the waste products are taken out. These are in the form of a dry powder and are removed without difficulty. Such a generator is six feet, six inches high and occupies a space twelve feet by six. This includes the holder also, which has a capacity of about 250 cubic feet, sufficient for 120 burners.

"A man who sees nothing but evil in another knows how to look for evil. Don't trust such a one."

DRILLING HOLES IN GLASS.

THEO. BROWN.

The making of holes in glass is an operation generally accomplished with diamond drills, but these tools are expensive, so that the amateur naturally looks for a less costly method. The writer has found the following a most efficient way, as well as an inexpensive one. Any size holes may be quickly drilled through sheet glass of any thickness, or even plate glass, with precision.

A piece of ordinary brass tubing is fixed to a lead weight, as shown in section in Fig. 1. *A* is the weight, *B* a groove capable of taking a driving belt, and *C* the brass tubing forming at *D*, the cutter. If holes ¼ in. in diameter are required, a tube of such dimensions is used, and the head *A* should weigh about 3 pounds. The tubing may be placed vertically in a suitable mould and the molten lead poured into the mould. The whole is then placed in a lathe and turned up true, the groove *B* being made at the same time. Figs. 2 and 3 show the other apparatus necessary, namely, a supporting framework for the drill, and a driving wheel *E*, consisting of a cycle wheel. The drill support F and G is fixed to a baseboard *H*, which may be fixed to any ordinary table *J* by means of the clamps *K*. Metal plates *L*, fixed to the wooden framework, act as bearings for the tubular drill *C*. *M* represents a sheet of glass to be drilled, *N* a rubber cushion consisting of an ordinary umbrella ring, and *O* a movable block placed just under the point of the drill. A wooden support *P*, is provided on which to mount the cycle wheel, which is held in a horizontal position and turns on its own hub. A handle *Q*, pivoted to blocks clamped to the spokes of the wheel, is used to operate the appliance. A crossed belt from the cycle wheel to the lead weight of the drill drives the latter. The teeth of the drill are formed with a triangular file.

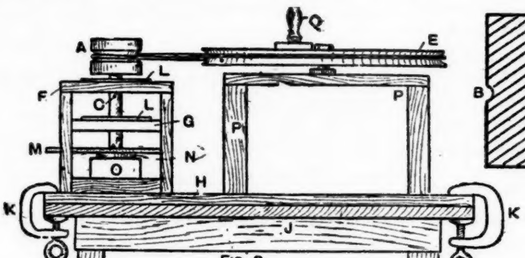

FIG. 2

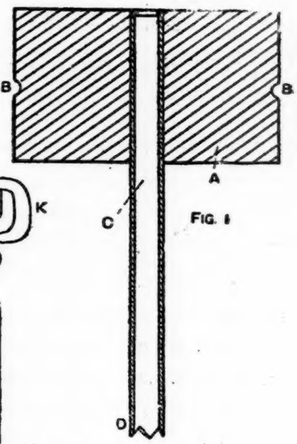

FIG. 1

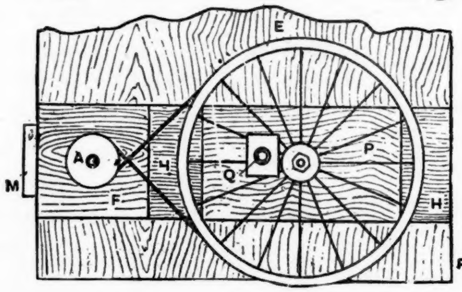

FIG.

It now remains to state the materials necessary for grinding and the mode of operating. The brass tubing alone would not make its way through the glass, however fast it might be revolved. Turpentine together with powdered corundum are the materials needed, the turps being poured down the tube from the top opening, and the corundum fed down the same channel while the drill is revolving. A loose wire rod may be used to ram down the corundum, but care must be taken not to cause a stoppage by a superabundance of this grinding material, otherwise it will give trouble, being most difficult to obtain a passage once the tube becomes choked.

The wire rod also serves to direct the flow of the turpentine to the bottom of the tube, where it is most required. If the corundum and turps have been properly inserted, a grinding sound will soon be heard after turning the appliance. The drill should be lifted slightly at intervals, so as to allow the corundum to get under the teeth of the drill. Properly operated, a ¼-in. drill can be made to cut a clean hole in a ½-in. thick plate glass in less than two minutes. This is working the machine by hand.

AMATEUR WORK.

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SEPTEMBER, 1906.

Owing to the nature of a number of communications recently received, and for which answers are requested through the correspondence department of the magazine, it is desirable to explain the purposes for which this department is conducted. The amateur worker frequently meets with problems the solution of which cannot be conveniently secured, owing generally to the lack of acquaintance with some one skilled in the particular matters at issue. As this magazine has a large number of contributors who are workers in many different lines, it is a simple matter for us to refer an inquiry to the one most acquainted with the subject, and an answer easily obtained. This service we are pleased to render when the subject matter would be of interest to anyone other than the person making the inquiry, as much interesting information is thus made available for all our readers.

When, however, an inquiry involves considerable mathematical work which would be of value only to one person, such as working out the winding specifications of a dynamo of unusual or discarded type, we shall hereafter be obliged to receive such inquiries subject to the convenience of those to whom they may be referred for answer, and no one should be disappointed if no answer is returned, although in such a case, if stamp is enclosed, the writer will be informed why no answer can be sent.

As we desire to make the magazine of the greatest usefulness, and as many readers are likely to have problems of a technical and personal character for which they desire solutions, we have decided to receive such inquiries subject to a fee, the amount of same to be as small as can consistently be made, and which will be communicated to the writer before referring the inquiry foı answer. In this way we shall be able to give our readers skilled technical service at the lowest possible cost, and avoid the feeling of reluctance held by some, who wish information but have refrained from writing for it because of the amount of work required to properly prepare an answer.

Owing to the large number of replies received in the suggestion offer mentioned in the editorial column of the June number, the announcement of the awards has been postponed to next month. Our sincere thanks are given to those who have so kindly aided us with so many valuable suggestions, which will be acted upon as soon as possible.

A jet of burning oxygen from a blowpipe is now successfully employed to cut sheet iron, iron tubes and small bars. The cut made is almost as sharp and thin as that made by a saw. In the earlier experiments difficulty was encountered in clearing the cut of liquid metal, and in preventing the spread of the melting effect beyond the borders of the cut. In the process as now practised, two blowpipes are employed. The first has an ordinary oxyhydrogen flame, which heats the iron to redness at the place where the cut is to be made. This is to be followed immediately by the second jet, composed of pure oxygen, which instantly burns the metal without melting. The liquidized iron is blown swiftly from the fissure, so that there is no serious spreading of the heal to the surrounding parts.

A SECTIONAL SKIFF.

CARL H. CLARK.

The skiff herein described is arranged to be easily knocked down for stowage or transportation. Its length is 10 ft. and its beam 3 ft. 8 in. easily carrying four people. When knocked down it stows into a package 3 ft. 8 in. square and about 1 ft. 6 in. deep.

This kind of boat is very desirable for yacht tenders, as it may be taken apart and stowed in the cockpit on a long run, or in a heavy sea, thus relieving the yacht of the drag or the liability of the loss of the tender by swamping. For camping or fishing parties it is especially valuable, as it may be transported in a team along with the other dunnage.

It should be a matter of about five minutes to put it together, and somewhat less to take it apart.

The general shape and construction is similar to the nine foot skiff previously described, but is of somewhat lighter construction for the special purpose of making it light for ease in handling. As will be noted in Fig. 1 the boat is divided into three portions by cross partitions, forming three separate sections which are held together in a manner to be described and which, when taken apart, may be stowed one inside of another. The oars, also, are jointed and stow with the other portions.

The boat may be built of pine, cypress or any other light stock. The sides are ⅜ in. thick and should, if possible, be in a single width of 15 in. and 16½ ft. long. The bottom is ⅜ in. thick and is put on crosswise. The sternboard is ⅞ in. thick and the cross partitions are ⅝ in. Fig. 7 shows the actual shape of the sides before bending. The boards should be cut to this shape and stiffened temporarily by three or four cleats to prevent their splitting while being bent into shape.

Figs. 4, 5, 6 show the shapes of the sternboard and partitions. These are gotten out from the proper stock, two of each of the partitions. One of each of the partitions and the sternboard are now set up and the sides bent around. The stem is of spruce about 2 in. square and is fitted into the forward angle of the sides; the partitions should stand in the proper positions, exactly vertical and their lower edges ½ in. above the lower edge of the sides. The two partitions just fitted are *A* and *C*, the end partitions of the middle compartment, and should be 3 ft. 8 in. from outside to outside; the bevel must be correct for the sides, and they must fit neatly. The remaining two partitions, *B* and *D* are now to be fitted adjoining those already in place, to form the ends of bow and stern compartments. They must be very neatly fitted about 1-16 in. away from those already in place, to allow the insertion of a saw for cutting the sections apart.

Corner pieces of oak 1 in. square, as shown at *a a* are now to be fitted in the inside corners of the partition *A* and *C* and fastened well with 1½ in. galvanized wire nails driven both through the sides and the partitions. Boat nails should not be used on account of their size and tendency to split. When the partitions *B* and *D* have been fitted in place the corner pieces *b b* are to be fitted. The partitions *B* and *D* are now to be removed and the corner pieces fastened on to them. The partitions are then put into place with a 1 16 in. strip of board or paper between them and the others and well fastened. Light corner pieces should also be fastened in the corner between the sides and the sternboard.

The boat is now turned over and the lower corner cleats *c c c* are fitted; they are ½ x 1 in., bevelled to the proper angle and bent around ½ in. above the lower edge of the sides; they fit neatly between the corner braces, which are cut off flush with their lower edges. Corner pieces *d d*, Figs. 1 and 8, of the same size, are also fitted on the lower edges of the cross partitions and sternboards to give adeitional bearing for the bottom plank.

The bottom boards are now ready to be fitted, beginning at the ends and working towards the middle; at the bow the boards should extend to the extreme corner, the stem being cut off to allow this. The bottom boards lie between the sides and the corner strips before fastening.

The ribs are of pine 1 x ⅝ in; they are notched at the lower end to fit over the corner pieces *c*, as shown in Fig. 3. They are placed as shown in Fig. 1 and are fastened from the outside with the exception of one nail in the lower end, which is driven from the inside; these ribs prevent the sides from splitting and stiffen them.

The gunwales are 1½ x ⅝ in. and are fitted as shown in Figs 1 and 8, on the inside of the ribs and corner pieces; these are, of course, put in in three pieces between the partitions. They should be steamed, or at least wet with hot water before bending in, as they are depended upon to preserve the curve of the sides *c c c*, thus making a double joint which is very strong and tight. Fig. 9 shows how the nails should be driven; *m* and *n* should be at close intervals, about 2½ in, *p* should be about 3 in, apart and *o* about 4 in. apart, as they are merely put in to prevent the sides being split by the number. The bottom boards should be put on in widths of about 8 in. It is advised that the boards be so arranged that a joint will occur between the partitions, thus avoiding the necessity of sawing the bottom and also of giving a good guide for driving the nails into the partitions.

The last board to be fitted should be at the widest part; owing to the under bevel it will be necessary to

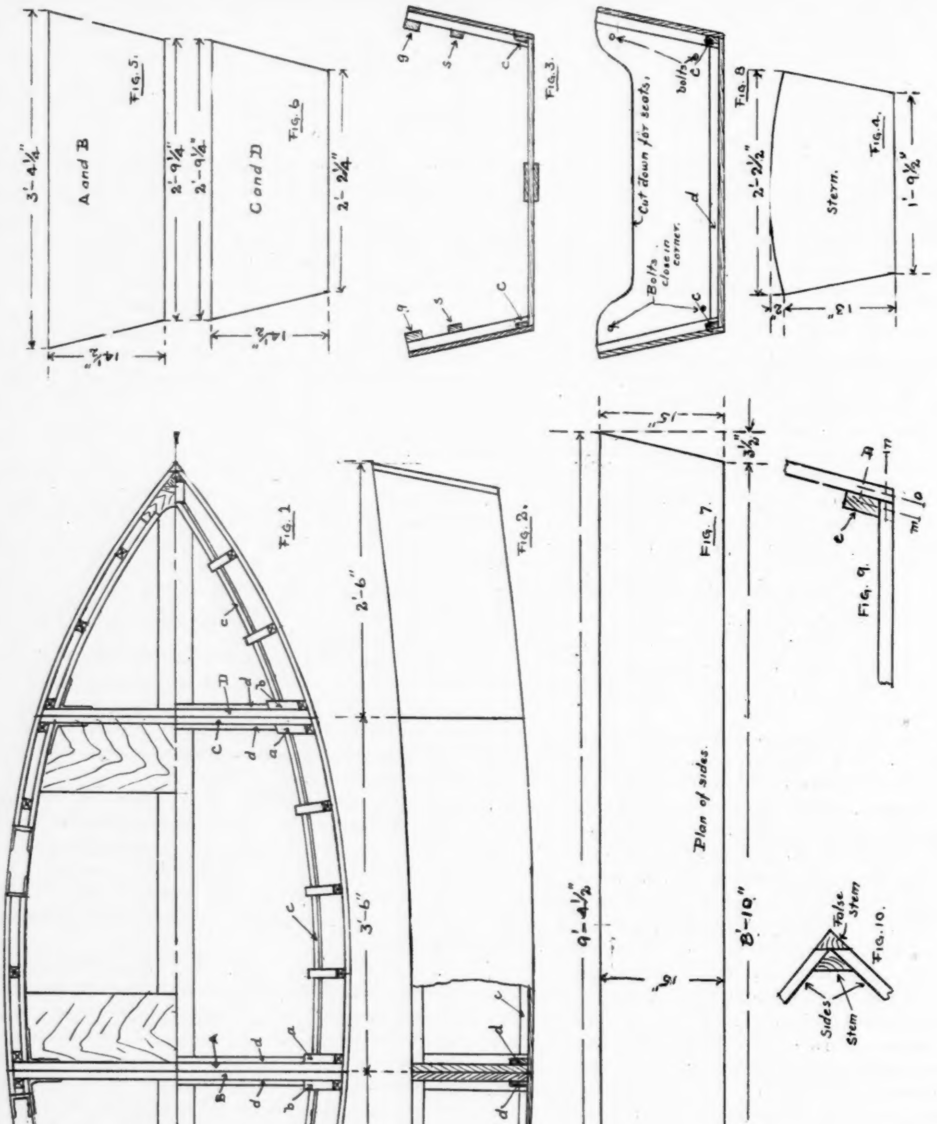


Fig. 1
Fig. 2
Fig. 3
Fig. 4
Fig. 5
Fig. 6
Fig. 7
Fig. 8
Fig. 9
Fig. 10
A and B
C and D
Stern
Plan of sides
Cut down for seats
Bolts close in corner
Bolts
False stem
Sides
Stem
3'-4¼"
2'-9¼"
2'-9⅛"
2'-2¼"
2'-2½"
1'-9½"
2'-6"
3'-6"
3'-0"
9'-4½"
8'-10"
Carl H. Clark

spring the sides slightly to get it in; this can be easily done if the adjoining boards be left loose until the last is in place. All joints should be well filled with lead after cutting. For fastening these gunwales in place, copper nails should be used, which should be bored for, and clinched over burrs on the inside. Brass or galvanized angles should also be fitted as shown. At the bow a wooden breast hook should be fitted, and at the stern a wooden knee, as shown in Fig. 1.

It is advisable, if possible, to allow the boat to lie a few days before cutting apart, to allow the curved parts to partially set into place and thus reduce the tendency to straighten. In the meantime the bottom stiffeners, outside and inside, may be fitted, of ½ in. stock, 4 in. wide; they are through fastened and clinched. The false stem *s*, Fig. 10, is now to be fitted, the boards having been simply lapped on the sides of of the stem. The false bottom should extend ½ in. below the bottom, the bottom stiffener butting against it.

The partitions should be cut down as shown in Fig. 8 to increase the inside room, and the edges bevelled off. A piece of oak half round moulding about ¾ in. diameter should be run around the outside even with the gunwale and well fastened with brass screws. A screw should be driven closely on each side of each joint to prevent the moulding from springing off when cut.

Four 5-16 in. holes should be bored in each pair of partitions, as shown in Fig. 8, for the bolts which hold the sections together.

The sides should now be cut, the sections separated and the ends smoothed up.

The seat supports, *S* Fig. 3, are 1½ in. wide by ½ in. thick, and are bent around on the inside of the frames; the upper edge being 5 in. below the gunwale. They are fitted in all three sections.

The whole should now be given a coat of priming paint, except the gunwale and half round, which may be coated with shellac. To fasten the sections together, three 5-16 in. bolts, 2½ in. long under the head, will be required; they should be fitted with thumb nuts and two washers each. To prevent leakage around the bolts, soft rubber washers are inserted under the iron washers.

Rowlock blocks and sockets are fitted in the positions shown; the after pair are intended for use when one or three persons are in the boat, and the forward pair when occupied by two people; the blocks are about 8 in. long and are fastened to gunwale and top of planks with screws. For rowlocks any desired pattern may be used.

The seats, with the exception of that in the bow, are loose, but may be held in place by notches fitting over the frames. The bow seat should be permanent and be fitted with a locker underneath for the stowage of the rowlocks, bolts, etc., during shipment.

The oars should be of spruce 6½ ft. long. When used as a tender they need not be jointed, but for camping or fishing purposes they should be furnished with a joint consisting of two pieces of brass tubing, fitting closely, one inside of the other, the inside piece should be about 6 in. long, and the outside one about 12 in. The oar is cut and the larger pieces fitted to a larger piece of the oar; the smaller piece is then trimmed down to fit inside of the smaller tube; this enables the oar to be jointed together for use. It should be so cut that the two portions are of equal length after the tubes are fitted.

A strong eye should be provided inside at the bow for the painter.

The whole should now be given two coats of paint inside and outside; all seams should be filled with putty, and if of any size, a thread of cotton may be forced in with the edge of a putty knife.

When joined together this boat should be as tight and satisfactory as an ordinary skiff, with the additional advantage of the sectional construction.

WINDMILLS FOR LIGHTSHIPS.

The Canadian exploring steamer, "Arctic" (Capt. Bernier), which has made an extended voyage North Poleward is provided with a novel electric light installation. Since fuel cannot be obtained for the generation of steam, and as the ship will have to spend many months in darkness, it was decided to instal an air-compressor plant which is being operated by a windmill. The compressed air is used to drive the generators, which in turn furnishes current for charging the storage batteries used for lighting the vessel.

It would seem that windmills might similarly be utilized on board of lightships and alongside of lighthouses, for generating electricity for illuminating purposes and for the signal lights, in connection with electric storage batteries.

On Nansen's ship the "Fram", there was a windmill electric set installed to give power during her Arctic voyage, and a similar set was placed on the ship "Discovery" during her Antarctic exploring expedition, both of which worked admirably.—"American Shipbuilder."

Very beautiful effects are now obtained by engraving the surface of diamonds. A French jeweller, Bordinet, has invented tools for this purpose, which, it is said, only his son is permitted to use. Among the surprising things produced is a diamond cut into the form of a ring, polished on the inside, and covered with delicate engraving on the upper surface. Another is an engraved diamond fish. Diamonds are also engraved with armorial bearings. Only in the past few years has it been possible to bore holes through diamonds, but this feat is now accomplished in many cutting establishments. The bored stones are then strung together with other gems, or with pearls.

INDOOR WORK FOR PHOTOGRAPHERS.

R. G. FRANCIS.

I propose in this article, which is intended for the beginner rather than for the expert, to give directions for some of the simple things which are not always simple for the beginner. In the first place, I will speak of printing. When the tyro commences to print from his own negatives, he naturally turns to a printing-out paper. This is inevitable. The simplicity of working, the visibility of the image, the sharpness of the results, all appeal to him. He vigorously makes prints from his negatives, tones them in a combined bath, soaks them in water for a while, and gives them to his friends. They are pleased with the results, and so is he—for a time. At the end of a few months he finds that his prints have faded, and is told that it is the fault of the paper, on which permanent prints cannot be made.

Possibly not. Yet prints can be made on printing-out papers, which, if not absolutely permanent, will last a number of years, even under poor conditions of exposure to light. The fault has been with the maker and not with the paper. If he had toned with a gold solution, fixed in plain hypo, and thoroughly washed his prints, they would probably have lasted as long as he cared for them. He gets disgusted with the process, however, and asks some friend or dealer what he shall use, and is told to use a gaslight developing paper. The advice is sound, and the examples shown him are good, so he invests in a package of paper and a tube of M. Q., and goes home to make some beautiful black and white prints.

DEVELOPING GASLIGHT PAPERS.

He gets into trouble immediately, for I never knew a beginner to make good prints from his first package of paper. The thing is very easy when you know how, but the difficulties of explaining in any way except by demonstration before the gas-jet, are very great. The beginner cannot appreciate the necessity for absolute chemical cleanliness which exists. He has developed plates, put his fingers in the hypo, and back into the developer, and it has had no effect on the negative, as far as he could see.

When he makes his Velox prints, he finds mysterious stains and streaks and blotches on them. His expert friend says they are hypo stains. The beginner protests that he washed his hands carefully each time he put them in the hypo. He forgets that once or twice he wiped them on the towel without washing them. That was sufficient. A very minute trace of hypo on the fingers is enough to cause the mischief. It is absolutely essential for the successful working of gaslight papers that the maker shall not touch the hypo with his fingers from the time he begins to print until the last picture is fixed. It is necessary to push the prints under the surface of the hypo, and for this purpose a smooth stick or glass rod should be used. This should be long enough so that the end which is held will not become wet with hypo. In this way it is possible to keep the fingers absolutely clean and avoid the most prolific cause of stains.

FIXING AND WASHING THE PRINTS.

The next most important thing to do is to wash the print free from developer before putting it in the hypo. If the print is allowed to remain in a large quantity of clean water for two or three minutes after developing and before fixing, there is no excess of developer to discolor the hypo or the print. Of course, to obtain this result it is necessary to properly expose the picture. If it is over-exposed, it will be necessary to hurry it from the developer into the hypo and give it only a hasty rinse. If, then, it is not properly immersed at once in the fixing bath, the developer will be oxidized rapidly in the thin film of liquid caught between the print and the air, and the result will be a patch of brown decomposition products which will ruin the print

Even if the individual prints are not stained, the result of introducing developer into the hypo with each of them is to discolor it to an extent which may finally cause deterioration of the purity of the whites of the paper. In order to insure the permanency of the prints, it is necessary to wash them well. The fixing should last at least ten minutes, the prints being kept well separated during this time. The washing should last at least half an hour in running water, with current enough to keep the prints moving and well separated. If this is not practicable, the prints may be washed by passing through twelve changes of water, leaving in each about five minutes. The process may be shortened by piling up the prints and squeezing out the water each time they are changed from one wash to the next. In this way the water is removed as completely as possible each time, and diffusion can take place more rapidly in the next water.

BLISTERS.

It sometimes occurs, especially in cold weather, that when the prints are taken from the hypo and placed in the wash water, blisters form, spoiling the result. One cause for these is a considerable difference in temperature between the hypo and the water. This may be remedied by keeping the hypo at the temperature of the wash water. Another possible cause is the use of too strong hypo. The easiest way to remedy this is to use hypo of a strength of not more than one to four. If a batch of prints shows these blisters, it may be put back in the hypo, when the blisters will probably disappear. If then a batch of hypo of half the strength

of that used to fix the prints is prepared, and they are first changed to this and after a few minutes transferred to the water, they may be saved. The diffusion of the strong hypo solution does not take place so rapidly when this is done, and the blisters will not form.

A mistake which is often made by users of gaslight papers, is employing too contrasty brands of paper. The soft-working kinds are preferable for almost all negatives, and give much more harmonious prints. The so-called carbon brands, which give prints of great contrast, are not suitable for general use. Their special utility is the making of passable prints from negatives which are too thin to be printed on the special papers.

MASKING AND DODGING.

It often happens that the negatives which are employed for printing on these papers are far too dense in certain portions to yield good prints. For instance, it is very often the case that a full exposure has been made on a landscape with a cloud-covered sky, and that when the development is complete, the clouds have been buried. No possibility exists of properly printing the clouds and the landscape at the same time by straight methods. Gaslight papers are especially adapted for dodging, however. By masking the foreground, the clouds may be printed out, and then enough exposure given to the whole negative to print the landscape.

The usual method is to take a piece of cardboard cut roughly to the shape of the sky line. This is placed on the front of the printing frame and the exposure made to bring out the clouds, moving the frame continually in front of the source of light, so that no sharp line of demarcation appears. The space between the card and the negative assists in this vignetting. The card is now removed, and the exposure for the landscape given. If the handling of the card is skilfully done, the result will be very much better than a straight print from the negative. Very often it is not necessary to use the card. If the negative is inclined away from the light, and the dense portion brought very close to it, this part will receive a proportionately much greater exposure, and some very difficult negatives may be made to give perfectly satisfactory prints.

In the usual way of drying prints, they roll up and remain obstinately curled when dry. It is not possible to dry them face down, for they stick to the support and are spoiled; but if they are turned over when about half dry, the curling will be minimized. The dry prints may be flattened perfectly by drawing them under the edge of a somewhat blunt ruler two or three times in different directions.—" Photo Era."

No square peg was ever a success at filling a round hole. If you are a misfit, whittle off the corners, or find a square hole.

HOW TO CLEAN A LENS.

Custom teaches us that glass will stand any amount of washing and wiping without injury, but the lesson is wrong. It may hold good of tumblers and beer bottles, but when we come to the finer quality of glass of which lenses are made, and to the more highly polished and more accurately finished surfaces which they must possess, we find that it is hardly an exaggtion to say that we cannot touch the surface of the glass without permanently affecting it. Certainly a degree of roughness which is habitual in the cleansing of table glass would spell ruin to a lens in a very little while. Yet the writer has seen a photographer breathe on the glass of a costly anastigmat and give it a rub with the corner of a focussing cloth, with all the delicacy and care of a child cleaning a slate—but no more. Only two kinds of impurities should need removal from the lens—dust and grease.

Dust, and under this head we might include the dirt which may appear after a lens has got wet with rain or sea water, is best got rid of by a very gentle wipe with a piece of clean, washed cambric. Nothing is better for this purpose than an old handkerchief, washed out to remove laundry chemicals, and dried. Part of it should be dampened with clean water and the lens dabbed. In this way harsh particles of dust, and much dust is nothing but broken flint, are picked off instead of being ground round on the glass by rubbing. A gentle wipe with a dry part of the cloth completes the operation.

If the lens has got greasy from finger marks or otherwise, a little rectified benzine or ether may be applied to the handkerchief. Its surface must not be allowed to get quite wet with either because it might work into the cell and affect the cementing. The great thing is to remember that glass is easily injurable, and to act accordingly.—" Photography, " London.

The "Mechanical World" recently contained an epitome of a lecture by A. B. Roxburgh of the National Gas Engine Company, Ltd., in which it was stated that about one-fourth of all the gas made in Great Britain is employed in driving gas engines. The lecturer estimated that in the United Kingdom alone there are manufactured at least 200 gas engines per week. Averaging them at the very low size of 10 h. p. each would give a weekly production of 2000 brake h. p. It was deemed likely, however, that the actual amount is double that figure.

Only the very best copper and the highest refined spelter are ever put into cartridge brass. The requirements are such that other metals will not answer the purpose. The standard mixture is two parts of copper and one part spelter.

BAND SAW ATTACHMENT FOR LATHE.

E. A. R.

The accompanying illustrations show a band saw which can be attached to and driven by any lathe ranging from 3½ in. up to 5 in. centers. The frame, wheels and guides are of cast-iron, the spindles, bolts, etc., being of mild steel. These materials will make a much more satisfactory and workmanlike appliance when finished, than if it were constructed mainly from wood

dimensions can be taken from the plan and the side and front elevations respectively, which are reproduced to a scale of 1½ in. to the foot, while the enlargements are 3 in. to the foot. The web of the frame may be about ⅜ in. thick, while the ribs are ½ in. thick at the root and tapering outwards to less than ¼ in., as shown in the section, Fig. 2, taken at x x, Fig. 1. The pattern for the pulleys should be constructed in seg

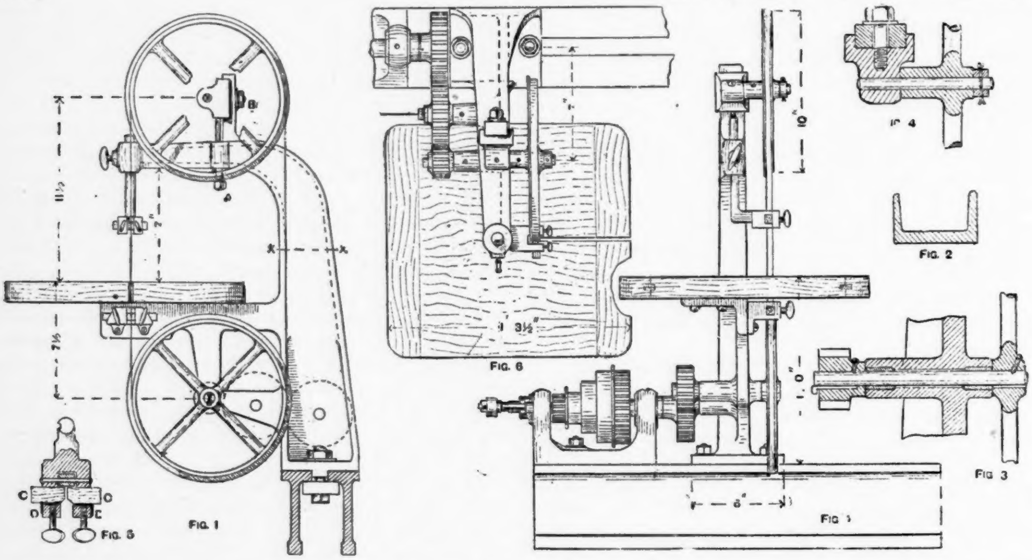


Fig. 1 gives a side view of the saw attached to the bed of a 3½-in. center lathe. The motion is imparted the saw direct from a 4-in. pitch diameter tooth wheel screwed to the mandrel nose and meshing to an intermediate wheel, also of 7 in. pitch diameter, which gears into a 2-in. pitch diameter wheel on the spindle of the band saw pulley. The gearing up, which is absolutely necessary, may be effected by a cycle sprocket wheel, bolted to a small face plate on the lathe, and a hub wheel on the pulley spindle with a suitable length of chain. The band saw will require a good deal of power to drive at anything like the prescribed speed for these tools, which is about 4000 feet per minute. It is doubtful if much more than 2500 ft. speed could be attained on the foot lathe, without excessive fast pedalling or high gearing, and in the latter instance it will probably be necessary to fit an extra flywheel to the crankshaft to get the required momentum to keep the saw going at a high speed.

It will be necessary to make a pattern for the frame for casting; pine is the best wood for the purpose. The

mental ribs, glued and pegged together, and turned in the lathe; or the wheels may be purchased complete. A small pattern will be required for the adjustable slide which carries the upper wheel, and also for the lower saw guide under the table. The top guide may be a mild steel forging.

When the castings are received, fit the tenon and base to the bed, drill holes for the holding-down bolts and clamp plate, and place the frame close to the lathe centers and transfer the height on to the casting. Next lap the train of gear wheels in mesh flat on the bench, and carefully measure off their centers and transfer them to the casting by holding a square with the stock on the casting, and the edge of the blade exactly over the lathe center mark previously mentioned and measuring off the centers on to the bosses for receiving the intermediate and driving pinions.

Another method is to first secure the 4 in. wheel to the lathe either by screwing direct to the mandrel, or by fixing to a driver plate, and then to gear the remaining pair of wheels to the first. Hold them in this

position and bring the frame up close to them and bolt down and scribe the centers on to the chalked bosses of the castings through the bored holes of the wheels, taking care not to have the teeth too deeply in gear while doing so. The same method can be adopted when using the cycle chain and sprocket wheel for driving. Next mark off a $\frac{5}{8}$ in. diameter hole for the shank of the top saw guide, and a $\frac{1}{2}$ in. tapping hole for the adjusting screw *A*, Fig. 1.

Also drill a hole $\frac{1}{2}$ in. in diameter near the bottom of the vertical arm *B*, Fig. 1, and with a hack saw cut the slot right down to receive the stud in the adjusting slide which carries the upper wheel. Drill six 5-16 in. diameter holes for securing the oak table to the frame. The most important holes are the $\frac{3}{4}$-in. tapping holes for the stud of the intermediate wheel, and the longer $\frac{3}{4}$ in. diameter hole for the driving spindle. This latter hole may with advantage be opened out to $\frac{7}{8}$ in. and bushed to receive a 11-16 in. diameter spindle, as shown in Fig. 3. The hole for the shank of the top guide should also be drilled carefully at right angles to the base.

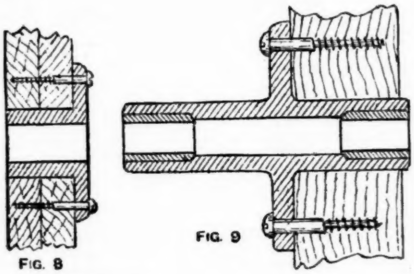


FIG. 8 FIG. 9

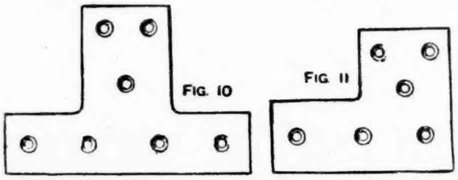


FIG. 10 FIG. 11

Fit the adjusting bracket over its slide, and drill and tap the hole for the $\frac{1}{2}$-in. stud; see Fig. 4. Also drill the hole for the $\frac{5}{8}$-in diameter spindle which carries the wheel. If the latter cannot be obtained with a long boss as shown, the boss can be made to project out to meet it when making the pattern for the casting; or the alignment of the two wheels can be regulated by inserting a suitable washer between the wheel hub and the bracket.

The lower wheel and pinion is keyed and set-screwed to the spindle, while the top wheel runs on its spindle, the latter being either tapped in or fixed with a grub screw. Mount the wheels in position, stretch a fine wire around them and make a rough pattern in wood of the top saw guide. Get them forged by a blacksmith, a section of this guide being given at Fig. 5. The thrust of the saw is taken on a small, hardened steel roller, and the side play is avoided by fitting two small, hardwood guide blocks *C*, retained by the thumbscrews, which are set upon small pieces of sheet brass, *D*. The lower guide is of the same construction in detail. It is of cast iron or brass, as preferred.

The table is of oak $1\frac{1}{4}$ in. thick by about 1 ft. 4 in. sides, end clamped as shown in Figs 6 and 7. A slot about $\frac{1}{4}$ in. wide is cut in the table to facilitate the removal of the saw. The table and guides should be set and filed while the wire is in position. It may be well to mention that 10 in. diameter pulleys are about the smallest it is practical to use for a small saw. The makers of small treadle band saws generally use a wheel at least 4 in. larger in diameter, and some also cement on to their wheels an endless rubber band for the saw to ride upon, to prevent damaging or breaking the blade. If rubber bands are adopted, provision must be made for the extra diameter of the wheels, and the pattern lengthened at the outer arm carrying the top saw guide.

Fig. 8 shows a method of constructing the pulleys from layers of wood cut in sectors of a circle, glued, pegged and lap-jointed together, and fitted with a gun metal or cast-iron flanged hub, which is attached to the wheel with screws. Fig. 9 shows the method of forming the bearers for the stud and the spindle of the intermediate wheel and pinion. The framing should, in this case, be of oak or beech $2\frac{1}{2}$ x $4\frac{1}{2}$ in. and secured at the arms and base with a plate of T or L shape, as shown by Figs. 10 and 11.

The "Pyrophone" is a new automatic fire detector, for which it is claimed that it makes the detection of fire in its earliest stage certain, makes false alarms impossible, gives a "danger call" preceding each fire call, and requires no fixed degree of temperature in order to give the alarm. The apparatus consists of a small U-shaped glass tube half filled with mercury in each end. One branch of the tube is exposed, while the other is covered with insulating material. When there is a sudden rise of temperature the liquid in the non-protected branch expands, thus driving the mercury downwards below a platinum wire which enters the tube and causes a danger signal. If the rise of temperature continues the mercury still falls lower, and below another platinum wire, breaking the circuit and causing a fire alarm. The indicator board shows "trouble" "danger," "fire," "earth" and "battery" disks, thus providing for every emergency.

Gasoline, like all other products of crude petroleum, was for a long time disposed of as waste in the effort to make kerosene. It is the first and highest distillant of crude petroleum. Gasoline is extracted by distillation just as whiskey is produced and in much the same kind of apparatus.

CHUCKS FOR HOLDING SMALL TOOLS.

B. N.

Too little attention is given to the selection of means for holding the small sizes of tools in the lathe. This attention becomes all the more necessary in the case of tools used in specialized machines. In making a selection, it is necessary first to consider the conditions under which the chuck is required to operate. If the clearance offered by the work in hand, the jigs, fixtures, etc., is sufficient, then one of the several forms of inserted spring chuck will usually meet the case.

requires no draw spindle; like Fig. 2, it takes a solid stock spindle or holder, according to the purpose to which it is to be applied. Adjustment of the chuck, Fig. 3, is effected by squaring the projecting portion of the collet for a suitable wrench.

Fig. 4 shows another independent inserted collet-chuck which the writer has used successfully on several jobs where an extended tool was necessary. Its adjustment is rather clumsy compared with that of

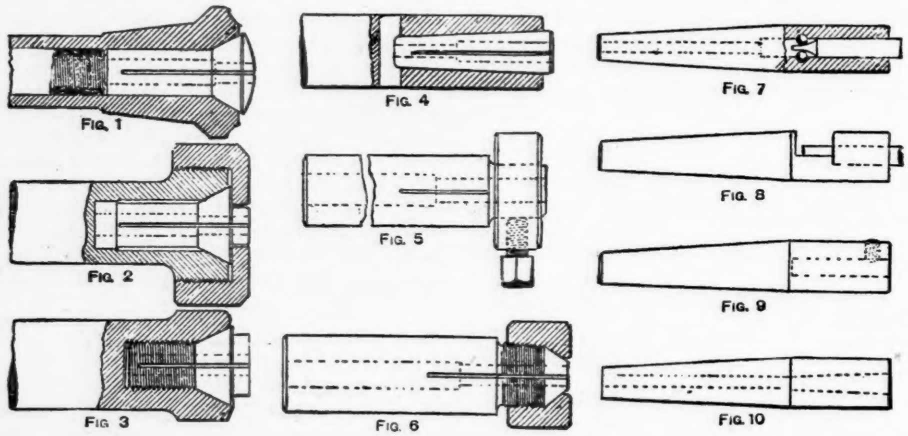


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5 Fig. 6 Fig. 7 Fig. 8 Fig. 9 Fig. 10

Fig. 1 is a common form of hollow spindle chuck, with draw in spindle engaging from the back, this being undoubtedly one of the readiest, truest and most secure means for holding this class of tool. Where the use of the draw spindle is impossible or inconvenient, however, a modification of this chuck becomes necessary. Two methods are shown at Figs. 2 and 3. Although somewhat more bulky than the others, that shown at Fig. 2 is an excellent device, and its value increases if the tool to be used are of various sizes. The inserted spring collet—not the simplest part to replace—having no threads, lasts a long time. This cannot be said of either of the devices shown at Figs. 1 and 3. In both cases a stripped thread would give a lot of trouble, while one worn chuck, if sets are used, may cause complications necessitating the making of a new screwed spindle and perhaps chucks as well.

On the other hand, the adjusting cap of the device shown at Fig. 2, being large in diameter, has a greater thread bearing, and consequently increased wearing capacity. Moreover, when worn it is much easier to repair. The chuck shown at Fig. 3 is in every respect identical with that shown in Fig. 1, but of course

the others. A hollow punch clearing tool is required to drive it home, and a taper drift passed through the cross-hole to eject it. In construction it is rather plain; about 4 or 5 degrees of taper should be given to the chuck, with the usual three slits for closing.

Figs. 5 and 6 are less elaborated devices, their chief differences from the others being that their use is confined to one size of tool. Still they are extensively used as a convenient form of fixed holder. If they are to be used in the hardened state, they require careful treatment, as they do not lend themselves readily to correction by grinding or other means; for this reason they are often finished and used soft. Fig. 5 is adjusted by a compression screw, and should have two slits; while Fig. 6 has a coned collar and three slits.

Figs. 6, 8 and 9 show chucks which are specially useful for outside clearance or long over-reach. Fig. 7 may be used as an extension for drilling or other operation giving pressure on the cutting end of the tool, and serving to keep the opposite flatted end tight between the two cross-pegs. Fig. 8 is a more familiar form, but not a very good one, the tool being liable to twist off at the back lip, which receives the cutting

strain. Hardening throughout and judicious tempering (low spring) of the back of the cutting tool partly checks this tendency.

Fig. 9 has a wider range of usefulness than the last two. The small holding screw should preferably be pointed and the tool slightly countersunk to receive it. Each of these three tools must be made a fit at the commencement, or they soon become unreliable. For a good substantial and reliable chuck, where a minimum of clearance is admissible, there is no alternative but to revert back to the tapered chuck, as in larger tools; see Fig. 10. The taper must be well finished and a good fit.

FISH KEPT ALIVE OUT OF WATER.

Fish, alive and kicking, may now be received at any distance from the waters in which they are captured. In other words, the salmon of the Columbia, the trout of Maine, the bass of Florida may be shipped to any part of the United States with as great facility as a bale of hay or crate of oranges. And when the fish reach their destination they are as lively as if they were in their native element, although they have not seen the water since they were taken from the sea or river. The possibility of doing this we owe to the Germans, and in a recent issue of "Der Tag" (Berlin) Hans Dominik tells us how it may be done. Mr. Dominik says:

"A short time ago I went to the laboratory of Dr. Eugene Erlwein, and this gentleman showed me a large glass case which was fitted with shelves like a bookcase; on the shelves I saw a large number of fish of every variety. There were fat carp and pike, trout and bass, and other watery denizens, and they were all well and happy—they moved their gills and fins exactly as though they were in the water, although they had not felt this element for thirty hours. The manner in which this was accomplished was soon explained to me."

Mr. Domirnik says that the floor of the case was covered with a thick layer of damp cloth; this kept the air in the receptacle moist, and the gills of the fish in consequence never became dry. But further investigation showed that the air in the box was not air at all, but pure oxygen; beside the case there was a large steel cylinder filled with oxygen. A tube led from the cylinder to the base of a jar filled with water, and another tube led from the neck of the jar into the box containing the fish. Says the writer:

"As I watched the apparatus I saw the oxygen bubble through the water of the jar and then, after being saturated with moisture, pass into the case. But the oxygen in the case was not stagnant; there was a pipe at one end which allowed the excess oxygen to escape. It was now clear to me how the fish could be kept alive and happy without water—the oxygen passed through their wet gills and into their blood in exactly the same way as if they were in water, while the carbonic acid gas from their lungs was carried off with the excess oxygen.

The afternoon of my visit the fish were taken from the case and put in the water. For this purpose the the oxygen was cut off, the top of the case unscrewed, and the fish thrown into tubs filled with water. It was at once apparent that the treatment had in no wise injured the creatures. The tench immediately became lively and animated; the thick Polish carp at first seemed a little dazed by the pure oxygen, but after a few minutes was thoroughly awake; the pike were the slowest to react. After a period of ten minutes the pike were still sluggish; the oxygen tube was therefore pushed under the water and into the fishes' mouths, and when the gas began to bubble through their gills the creatures were at once restored."

Mr. Dominik says that in these experiments the case contained three hundred weight of fish, while the case itself only weighed one hundred weight—thus there was only one-fourth dead weight. Dr. Erlwein has, however, carried his experiments further along this line, and he has now patented a special fish-car for use on railroads; in this car the above principle is used, but with slight modifications. Thus the fish are placed in a little water in the car, and the water is kept in constant circulation by means of small pumps. As it circulates the water passes through an apparatus which extracts the carbonic acid and injects the fluid pure oxygen. The fish in this way may be kept alive indefinitely.—"Literary Digest."

REMOVING SPECKS FROM THE EYE.

Some engineers are very skilful in removing specks from the eyeball, states the "Engineers' Review." Take a splinter of soft wood, pine or cedar, and whittle it to a point. Then take a small, loose flock of cotton, and laying it upon your forehead, place the pointed stick in the center of it. Then turn the flock of cotton over the end of the stick, winding it round and round, so as to make it adhere firmly. If you will look at the end of such a probe with a 12-in. lens you will see that it is quite rough, the fibers of the cotton making a file-like extremity. As the material is soft, it will do no harm to the cornea when brushed over its surface.

When ready to remove the foreign body, have the patient rest his head against your chest, draw the upper lid up with the forefinger of your left hand, and press the lower lid down with the middle finger, and then delicately sweep the surface in which the foreign body is embedded, with the end of the cotton probe.

DOVETAIL JOINTS.

[Continued from Page 286.]

have to force parallel surfaces apart. In most cases, therefore, it would be better arranged in the position shown in Fig. 13, where there would be greater risk of the vertical member being strained outwards than of the horizontal one being forced upwards. A dovetail joint like Fig. 13 is often employed in preference to a mortise and tenons, in which the surfaces of the joint are parallel in both directions.

with only a very slight increase in efficiency, for in either case the parts are usually held by screws or nails. To insure a tight fit and easy insertion, a slight amount of taper is often given lengthwise to the dovetail, and the groove it slides into, so that the former will enter slack, and be driven tight when the two parts are in their correct position with each other. Both Figs. 14 *B* and *C* are often made with only one side dovetailed and the other parallel with the surface of the piece that enters. The main object of this is to avoid the extra work of dovetailing both sides.

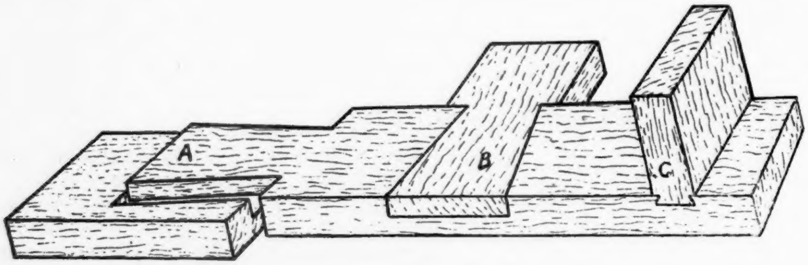


FIG. 14.

Fig. 14, *A* is a dovetail joint for uniting timbers end to end without the attachment of battens, or exterior means of securing them. An alternative to it is to cut the socket or recess in both portions, and insert a separate piece or key to hold them together. Fig. 14, *B*, is a dovetailed half-lap joint where the end of one member has to meet an intermediate portion of another. It might also, instead of going completely across, be stopped at some distance short, being then practically the same as Fig. 14, *A*, except for the difference in the direction of the grain.

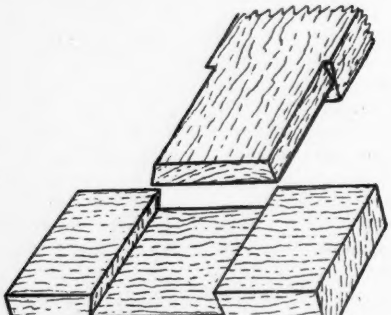


FIG. 15.

Fig. 14, *C*, is a dovetail joint sometimes employed for uniting pieces as shown, the dovetail usually being on end grain and the rebate across grain. It is an alternative to a plain rebated joint, but involves more work,

Fig. 15 is a half-lap dovetail joint differing from Fig. 14, *B*, only in the direction in which the dovetail is cut, Fig. 14, *B*, being designed to resist pulling back-

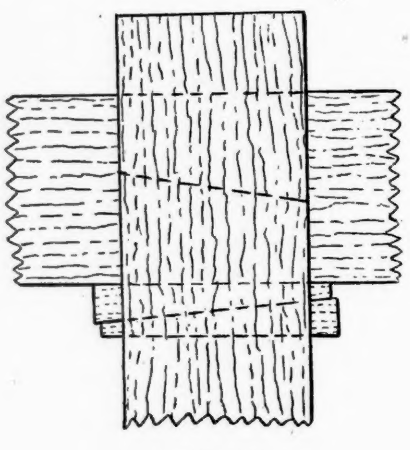


FIG. 16.

wards in the plane of the joint, and Fig. 15 to keep the broad surfaces together and flush on the exterior. Fig. 14. *B*. is employed more frequently than Fig. 15.

Fig. 16 is a dovetailed mortise and tenon in which the ends of two rails are united in a mortise in a post. A half dovetail is cut on the end of each rail, so that they will fit together with the rails in line with each other. The mortise is cut sufficiently wide to permit these ends to be inserted from opposite sides, and then

the dovetail is closed laterally and kept so by folding wedges which fill the extra width of the mortise, thus making it impossible to withdraw the ends without first loosening and removing the wedges. A single end may be wedged similarly by sloping one of the sides of the mortises to fit the dovetail. This is a very useful joint for temporary work.

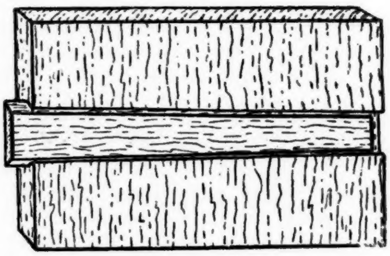


FIG. 17.

Fig. 17 is a dovetail key used for strengthening and keeping very wide pieces of wood from curving. Its edges are dovetailed similarly to Fig. 14, *C*, to keep it in place, and it is tapered lengthwise, so that it can be driven to a tight fit and further tightened if necessary subsequently to compensate for shrinkage. Sometimes the key stands above the surface of the other piece to give as much stiffness as possible; but it is, if necessary, planed flush.

A SMALL RHEOSTAT.

PAUL ZERRAHN.

The materials for making this rheostat are: A piece of hard black rubber 4x5 in. and ⅜ in. thick; ten short round-head brass screws.; six inches of ¼ in. bore, hard black rubber tubing, two binding posts, a quantity of No. 24 gauge iron wire, a small strip of spring brass and four round-bead machine screws 1⅛ in. long with nuts.

First cut out a piece of the rubber 2 in. square. Then cut out a bottom piece with projections the shape shown in Fig. 1. To know where to place the screws *c c c c*, draw four diagonal lines from corner to corner. This will give the center of the piece of rubber, as well as the points for the screws. Measure in on these lines ¼ in. from the corners, marking the points so obtained. On these four points drill ⅛ in. holes, and similar holes on the other piece of hard rubber. The points *e e*, are round head screws, with their points filed down until they are a trifle over ⅛ in. long under the head.

With a compass draw a circle, using the center obtained as above. Divide one-half the circle into seven parts, spaced ⅜ in. apart as in Fig. 1, and drill holes on these points just large enough to hold the screws *e e*, etc., firmly. Then put in the screws with heads on the bottom of the piece of rubber. The filed ends should come just through on the top.

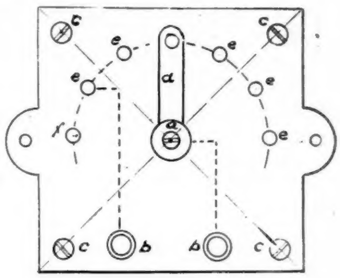


FIG. 1.

From the iron wire cut lengths about one foot long, and turn up spirals by twisting around a pencil or other cylindrical shape. Connect the points *e e*, by soldering to them the ends of the wire spirals, with the exception of point *f*, which has no spiral connection. Next attach the two binding posts, *b*. Connect one of the binding posts with last right-hand point *e*. The movable arm consists of a piece of spring brass with a hole at one end for the screw, by which it is attached to the center of the rubber piece having the points *e e*, and long enough to allow the outer end to make full contact with the points, *e e*. A knob *a* can be made from a small porcelain picture knob, or wooden knob such as are used on the covers of cooking utensils. To

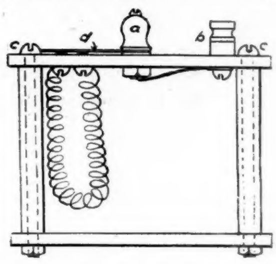


FIG. 2.

ensure the arm turning with the knob, a nut is placed on the machine screw binding the arm firmly to the knob. The screw is then put through the center hole drilled in the rubber and another nut added, fastening same with a drop of solder at the same time the wire is soldered to the screw connecting it to the other binding post.

The rubber tubing is then cut into four pieces 1¼ in. long, the long machine screws are put through the corner holes in the top rubber piece, the tubing slipped over them, the bottom piece of rubber put in place, and the nuts then tightened up, holding all parts in position, as in Fig. 2. The resistance here described can be used for regulating the current from batteries to small motors, miniature lamps, etc.

WEATHER INDICATOR.

J. S.

Having tried many different styles of weather indicators, I have found the kind to be described here to work well, and as the cost of making one is small, it will undoubtedly interest many readers of the magazine. The base consists of a board 20 in. long and 12 in. wide, which should be fitted with cleats on each end to prevent warping. On the back are fastened with round head brass screws, twelve small spools, similar to those used for twist. The screws should be an easy fit for the holes in the spools, and the holes should be smoothed out with a round file to get a good bearing. It would also be an advantage to fill the pores in the wood with powdered graphite, which reduces the friction. The arrangement of the spools is shown in Fig. 1.

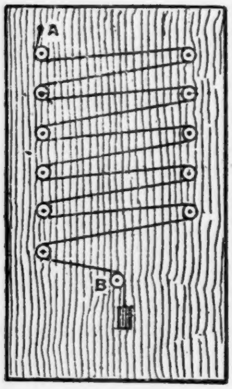


FIG. 1.

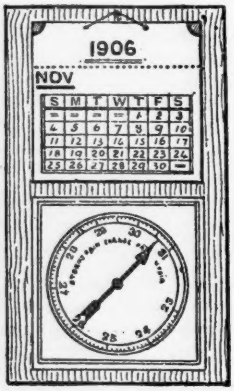


FIG. 2.

Obtain an E violin string and make a knot in one end and fasten with a screw at point *A*, Fig. 1; the string is then carried over the several spools and to the lower end is attached a lead weight, weighing about four ounces. On the front of the board a calendar or ruled record blank may be placed on the top portion. A dial is marked out on heavy card board, as shown in Fig. 2, cutting out a hole in the center to put the shaft or the pointer. The shaft is made of a piece of brass tubing or brass rod of a size to fit one of the twist spools with a drive fit. A hole is bored in the board at the point *B* Fig. 1, and a pointer is then fitted to the front end.

The pointer is cut out from a piece of thin brass or tin and painted black. The violin string is carried twice around this spool so as to turn the pointer in accordance with the variations in the tension of the string. The calibrating of the dial must be done after the indicator is in operation. The preferable way is to obtain the use of a regular instrument and by taking observations night and morning for several days, several points can be obtained from which intervening points can be worked out. If this method is not possible, it will be necessary to telephone to some weather observatory at stated intervals and get observations in that way. When complete the indicator is mounted in a vertical position in some place about the house, where it will not be reached by the rain or snow and yet be influenced by a change in the humidity.

GASOLINE NOT DANGEROUS.

Because gasoline can be used with better effect than any other hydrocarbon compound as an explosive mixture in the cylinder of an internal combustion engine, an impression prevails that gasoline must necessarily be extremely explosive, says the "Automobile Magazine." In this respect the more inert kerosene is much more dangerous than gasoline. If a vessel partly filled with kerosene is left open, air sufficient to create an explosive mixture is likely to accumulate in the presence of the liquid, but gasoline stored under similar conditions gives off its gaseous emanations so freely that an air-charged mixture does not accumulate.

The combustion of gasoline either in burning as a fuel or as an explosive in a cylinder is practically the same natural process as the combustion of any other fuel. The hydrocarbons of which it consists combine with oxygen when raised to the proper temperature and produce water and carbon dioxide. In the ordinary combustion of gasoline the vapor passing from the liquid ignites at about 1500° Fahr., when combustion will proceed as rapidly as the admixture of combustible and oxygen can be combined. When the air and fuel are mixed in the proper proportion combustion becomes explosion; but the mixture is the same as that which goes on in the slow combustion process, producing water and carbon dioxide.

Gasoline, although very inflammable, produces an inert gas, unless it is mixed with the proper proportion of air or oxygen that makes it an explosive. The effective mixture of air from which the oxygen is drawn and the vapor of gasoline varies from 6 to 1 to 11 to 1. Mixtures above or below these proportions may be entirely useless for power purposes, and they would not cause an explosion in the open air or even in a confined chamber.

Gasoline is so volatile that if left in an open vessel or in a vessel having a vent, the gasoline vapor will force its way out, precluding any admixture of air. If sufficient heat is applied to ignite this escaping current of air, no explosions can happen, but the gas will begin to burn the same as a gas lighting jet. People become panic stricken about gasoline because they do not understand its peculiarities.

CORRESPONDENCE.

No. 158. CAMBRIDGE, MASS., JULY 7, 1906.

Will you please inform me whether is is feasible to use a small balloon for elevating the aerial wire for wireless telegraphy, and if so, give description for making one. H. J. C.

Balloons have been used to elevate the aerial wire for wireless telegraphy, but such use has been almost entirely confined to military work. A balloon of considerable size is required to give sufficient capacity to lift itself and the weight of an aerial wire of say, 10 pounds. If illuminating gas is used for inflating, a balloon of 1000 cubic feet capacity would lift only 32 to 37 pounds, according to the kind of gas and humidity of the atmosphere. The diameter of such a balloon would be nearly 13 feet, and the expense of inflating it would be considerable, as well as requiring considerable time unless a large supply pipe was available. The lifting capacity of hydrogen gas is about double that of illuminating gas, consequently the balloon would need to be only half the size for the same capacity, but a generating plant would be necessary. As amateurs make use of wireless telegraphy intermitently, it is decidedly the best plan to put the money required for a balloon outfit into other parts of the apparatus and make up through increased efficiency in these parts what is lost in a lower aerial.

THE SIMPLON TUNNEL.

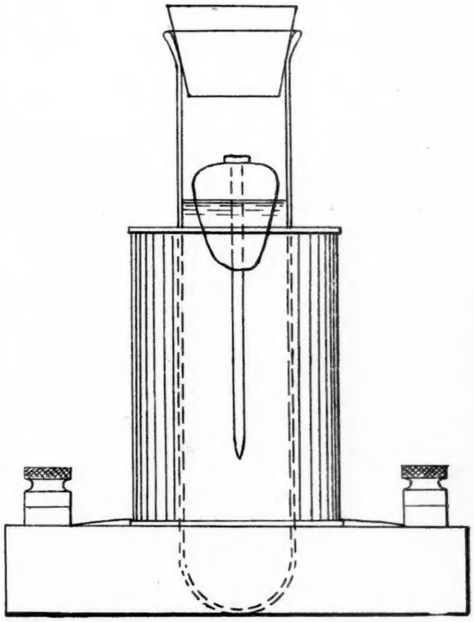
The new Simplon tunnel, which was recently opened to traffic, is being operated with little difficulty from the natural rock heat that is encountered near the middle portion. At the same time, the ventilation has proved very satisfactory, in spite of the use of the ordinary coal-burning locomotives which are required, owing to the impossibity of operating with the new electric motive power, until the locomotives are specially insulated and equipped to withstand the moist vapors encountered. The temperature experienced in the cars range as high as 80° Fahr. near the middle of of the tunnel and correspondingly lower near the portals, but owing to perfect mechanical ventilation this does not prove objectionable, and the gases from the locomotives are said to be nowhere evident.

The entire trip from Domodossola, near the Italian portal, to Brig, on the Swiss side, requires but little over an hour, at ordinary operating speeds. The unfortunate feature of the tunnel condensation of moisture from the heated air near the middle on the cooler surfaces of the cars and equipment passing through this condition having rendered the electrical operation troublesome until it can be provided against by enclosure of the apparatus liable to be affected.

SIMPLE CURRENT DETECTOR.

A. M. TROGNER.

To make a simple, yet effective current detector, procure a glass tube, some No. 25 wire, two corks, nails, and wood for base. Drill a hole in the baseboard large enough to insert the test tube. Make a card-board bobbin to fit over the test tube, so that when the tube is through the board and the bobbin is placed over it there will be from one to two inches of the tube clear above the bobbin, as shown in Fig. 1.



Then take a cork and cut to the heart shape shown in Fig. 2, the dimensions depending upon the size of the test tube. Insert an iron nail in the cork, making sure that the cork will bear the weight of the nail when placed in water.

The next thing is the winding of the bobbin. Five layers are wound of No. 25 copper magnet wire, and then covered with shellac.

To assemble the parts, first fill the tube with water, then place it in the cork float and cork up the tube. Next invert the tube and insert it, from the bottom, in the hole in the base-board. Then place the bobbin over the tube and connect the ends of the wire to two binding posts, and the instrument is ready for use. On passing a current through the wire the cork will sink down within the bobbin. If it does not, then loosen or tighten the cork stopper, or change the direction of the current through the bobbin until it does.

VACCINATING TREES.

According to Consul-General Guenther, of Frankfort, German papers state that it happens frequently that the roots of fruit trees are more exhausted than the parts above the ground, and so the life of the tree is threatened.

In order to prolong its life in such cases, it has been recommended to vaccinate the trunk of the tree with a solution of sulphite of iron, the same article which is used in the so-called anæmia or chlorosis (Bleichsnckt) of the grapevine. A Russian scientist, Mr. Sigismund Monrjetski, has now made minute scientific experiments with reference to the results of such vaccinations, and by employing colored solutions he has shown that the solution never enters into the old wood. It only follows the young growth, but it penetrates into the roots down to a depth of 1 meter (about 39 inches), while on the other hand, it penetrates up to the top of the tree. It is therefore deemed best to vaccinate the tree through a single opening of the neck of the root, and it should serve not only for the introduction of nutritive substances, but also of such liquids which, by killing certain bacteria, tend to cure diseases of the plant.

SCIENCE AND INDUSTRY.

For some weeks past the French War Office has been engaged in conducting experiments with a view to securing reliable communication for military purposes between Paris and the eastern garrison towns by means of wireless telegraphy. Though many difficulties had to be encountered, these were eventually overcome, and after the system had been extended as far as Vardon and Chalons, the important stronghold of Belfort was furnished with apparatus for wireless telegraphy. According to the "Electrical Engineer," London, there is now complete and permanent communication between Paris and all the eastern garrisons.

Kerosene, which is used for fuel to a considerable extent in combustion engines, is made from the distillation of crude petroleum. It takes on an average 3½ parts of crude oil to render 1 part of kerosene. The heat of combustion depends, of course, on the composition, but will range between 22,000 and 24,600 British thermal units per pound. The quicker the distillation, the poorer will be the kerosene, although it will be obtained in larger quantities. The burning point of kerosene is between 130 and 140° F., and it will boil anywhere between the limit of 300 and 500° F., giving a vapor density of five times that of air and requiring for its combustion nearly 190 cubic feet of air per pound.

A new method for increasing the density of steel is described in "Stahl und Eisen". The object is to allow for the escape of the occluded gases in the metal by keeping the upper part of the ingot in a fluid condition until the mass of the ingot has solidified. To accomplish this a burner cap is placed on top of the ingot mould and a gas blast flame is directed downward upon the metal; vent holes at the side of the cap allows the gases to escape. The flame is so proportioned as to keep the upper part of the ingot considerably above the melting point, thereby causing the ingot to solidify progressively upward. The metal can thus follow the contraction in volume, and the gases are free to escape.

What is said to be the largest wind engine in this country is a great Dutch wind mill recently erected on the Ocean Boulevard, San Francisco. The concrete sub-base is 43 feet in diameter, with walls tapering in thickness from 48 inches to 30, and rests upon a concrete foundation 50 feet in diameter and 54 in. deep. The four great arms have each a radius of 51 feet and a wind area of 400 square feet, making 1600 in all. The main shaft, which is 13 inches in diameter and 18 feet long, is elevated 12 degrees above the horizontal on the score of efficiency. The big 24-foot turret which keeps the big wheel always facing the wind. The lowest wind velocity at which the mill will operate is eight miles per hour, at which 5 horse-power is developed; at twenty miles 200 horse-power is obtained. The tips of the long arms always travel more than twice as fast as the wind.

The earliest mention of coal among the ancient authors is by Theophrastus, in his "History of Stone," wherein he says: "There is a fossil substance called coal which is broken for use; it kindles and burns like wood. It is found in Liguria and in Ellis, in the way to Olympia over the mountains. These coals are used by the smiths." It is very probable that coal as we know it was used by the primeval Britons for metallurgical operations. The Romans were undoubtedly acquainted with coal, for cinders, or coke, was discovered amid the ruins of their iron forges. It was certainly used by them in their pottery furnaces at Condata, Warrenton, where quarries of wigan cannel coal, and cinders or coke were found, in connection with an extensive collection of pottery, now preserved in the museum of that town.

When solid water becomes liquid, or when liquid water becomes gaseous, a considerable amount of heat is rendered latent. Steam issuing from boiling water is no hotter than the water itself; water formed when ice is melting is no hotter than the ice itself, yet heat is being communicated to the ice and to the water.

There is a huge natural magnet in Upper Burmah, India, covered with great blocks of iron ore, which has a tremendous attraction, rendering compasses and watches useless.